RECOMMENDATION SYSTEMS AND AI SOLUTIONS GUIDING OPEN (LIFE-LONG) LEARNING – A DEVELOPMENT PROJECT IN FIVE UNIVERSITIES OF APPLIED SCIENCES IN FINLAND

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Abstract

As a result of the corona pandemic, lives both at workplaces and universities have changed. Working "from anywhere" and studying online have come to stay. The pandemic has also caused significant changes in the demand and supply of labour, there are industries where job losses are a problem, and there are industries where there is labour shortage or there is a need to acquire new skills quickly, some people are even looking for a new profession.

Before the pandemic, in Finland, about 36% of the workforce was considering a change in career and a new profession. The corona pandemic added a special boost to these needs. One reason could be the lack of digital skills. According to a recently published study [1], half of the working population is lacking in digital skills and has difficulties with digital tools. This causes stress and burnout. The so-called "digital leap" and remote work have increased the need for learning new digital skills. As a result, there is an exceptionally high need for boosting skills, digital and others, in Finland. This is the need universities of applied sciences have recognized and responded to by collaborating with businesses and labour authorities to increase the amount and variety of continuous learning offering.

This paper aims to describe a development project, where recommendation systems and AI together are used to guide in the selection of open studies. We have co-created a joint artificial intelligence powered digital environment which is conceived as an ecosystem - a matching tool consisting of our study offering and the need for skills and labour in the world of work. In the system, people who would like to upgrade their own skills and knowledge have an option of taking studies matching their needs from our universities of applied sciences.

During the last decades, with the rise of Facebook, Amazon, Netflix and many other web services, recommendation systems have become omni-present. From e-commerce (suggesting to buyers products that could interest them) to online advertisement (suggesting to users the right contents, matching their preferences), recommendation systems are unavoidable in our daily online journeys. For a higher education institution (HEI) to use recommendation systems in marketing their learning offering, they should pause to think whether they serve customers, students, or both.

This paper discusses ways of using recommendation systems in guiding people looking for upskilling and reskilling offering, and of using artificial intelligence to identify the skills needed in the world of work and meeting those needs in higher education institutions. This all, in effect, constitutes the first building blocks of a digital learning ecosystem. In this paper, we will present some ideas and practical experience. By using a combination of recommendation system and AI, our "webstore" is fast, ecological, economical, reachable, and student or customer centred. The initial findings of the project are promising but tuning the recommendation systems and study offerings to work optimally together still requires work and tackling technical challenges. Even if we try to optimize the possibilities of recommendation systems and artificial intelligence, it does not eliminate the need for personal support and guidance of students.

We conclude that in the future, higher education will also be seen as a market-based activity (regardless of how it is funded) and that future learners will behave as normal consumers when looking for educational opportunities, and thus, expect similar functionalities.

Keywords: recommender systems, recommendation systems, e-learning, open learning, life-long learning, higher education, artificial intelligence, etech, continuing education

1 INTRODUCTION

This paper aims to describe a development project, AMKoodari, where recommendation systems and AI together are used to guide in the selection of open studies. The studies were all related to coding, and they were picked from the existing online offering in five Finnish universities of applied sciences: Haaga-Helia, HAMK, Laurea, Metropolia, and XAMK which jointly cover South-East Finland and the metropolitan Helsinki area.

In the project, we co-created a joint artificial intelligence powered digital environment which is conceived as an ecosystem - a matching tool consisting of our study offering and the need for skills and labour in the world of work. In the system, people who would like to upgrade their own skills and knowledge have an option of taking studies matching their needs from our universities of applied sciences. The planned coding education implementation model uses artificial intelligence in two ways: 1) in analysing the demand for talent/skills, and 2) in matching the learning offering to the needs of the job market and the learner. Additionally, we experimented on recommendation systems, one, a decision-tree type tool, and another, a mobile app for helping in the selection of courses. This app uses a variety of AI methods to analyse and sort relevant data.

The project received funding from the Finnish Ministry of Education and Culture in spring, 2019, and the first courses were made available in the fall term, 2019. This is also when we began collecting regular feedback from the students taking part in the courses. In this article, we will focus on feedback relating to recommendation systems and the systems themselves. In the actual project, we also placed special emphasis on developing guidance methods and ways that help adult learners in their often-solitary endeavours. These are discussed in more detail in the project report.

The timing of the project was fortunate. In mid-March 2020, southern Finland practically closed, and all higher education institutions took their teaching and learning offering online literally overnight. This gave a boost to academic professionals' online skills all over Finland and helped the project participants as well.

As a result of the corona pandemic, lives both at workplaces and universities have changed. Working "from anywhere" and studying online have come to stay. The pandemic has also caused significant changes in the demand and supply of labour, there are industries where job losses are a problem, and there are industries where there is a labour shortage or there is a need to acquire new skills quickly, some people are even looking for a new profession.

2 STUDENTS AS CONSUMERS

The AMKoodari studies were aimed at everybody, regardless of their earlier background. The studies were offered fully online to provide flexibility in studying, regardless of time and place. The AMKoodari studies served as a starting point for those looking for a career in programming or as further training for those who are already acquainted with the topic. However, in the funding decision made by the Finnish Ministry of Education and Culture, it was stated, that these courses are not to be offered to the degree students of the UASs.

The students´ perceptions of the offering were being measured quarterly with a feedback survey throughout the project. The surveys provided insight in the student profiles as well. According to the feedback survey of Q1/2021, students taking the courses were a very heterogeneous group. Although the UASs offering these courses operate mainly in Southern Finland, they were able to attract students from every part of Finland, even some students from abroad. In previous surveys, there had been more female than male respondents, but in Q1/2021 survey there were 57 % male versus 42 % female respondents. Ages of the respondents ranged from teenagers to retired. Most respondents were between 35 to 45 years of age. 82 % had more than ten years of work experience, but 54 % had no previous experience in programming. On the other hand, 15 % of respondents had worked as programmers.

More than 57 % of respondents had a higher education background. 66 % of them worked as employees but none of them attended the courses based on recommendation from one's employer. 7 % of respondents were entrepreneurs. None of the respondents intended to start a new company in the near future. Out of all respondents, 20 % were unemployed.

There were various reasons to take these courses: 42 % were looking for professional development and 25 % were planning for a career change. 16 % were studying these courses out of pure interest in the topic.

The common AMKoodari offering provided by the five UASs was wide, including topics such as basics of programming, business analytics, game design, mobile and web design, Internet of things (IoT) and cloud technologies. It can be quite challenging for potential students to find the courses that are best suited for them. On the other hand, individuals today are used to having personalized online advertisements offered to them when navigating across different websites. When using different web stores, they receive recommendations on interesting products based on their user profile. Recommendation systems are unavoidable in our daily online journeys. In higher education, recommendation systems are still a novel approach in the marketing of the learning offering.

In this project, the students with their heterogeneous background were regarded as online consumers. The need for a user-friendly, personalized interface was recognized from the very start of the project and development work to launch a recommendation system was started.

3 RECOMMENDATION SYSTEMS

In the project, we worked with a number of collaborators to create recommendation systems to support both students and universities of applied sciences themselves. Students benefited from having recommendations on courses to choose, and UASs had and AI system that helped in comparing how the courses and competences matched with the relevant job openings. In the following, we will describe the functionalities, experience, and future possibilities of these systems. As background, we describe how the students found their way to recommendation tools available via the AMKoodari website (https://amkoodari.fi).

Before any of the potential students found their way to the AMKoodari website, or to the sites of individual universities of applied sciences, we conducted a variety of activities to raise awareness and activate potential participants. Given that these people were anybody besides degree students at higher education institutions, the project reached out to employment officials (for the unemployed), to businesses (for the employed), and to the public at events and other channels. These activities are discussed in depth in the actual project report.

While the project had a specific website most often students found their way to courses directly via the websites of the participating five UASs. Turned out that social media also was a strong influencer throughout the project. The table below shows the division of sources from where prospective students learned about the studies on offer.

Table 1. "Where did you learn about these studies?"

Quarter	UAS website	Employment office	Friend	Employer	Social media	Fair/event	Other
Q2_2021	47 %	6 %	15 %	0 %	19 %	1 %	16 %
Q1_2021	36 %	10 %	18 %	-	24 %	1 %	15 %
Q4_2020	32 %	15 %	15 %	1 %	24 %	1 %	15 %
Q3_2020	23 %	36 %	14 %	-	25 %	-	10 %
Q2_2020	37 %	5 %	17 %	1 %	33 %	1 %	12 %
Q1_2020	33 %	2 %	23 %	4 %	27 %	1 %	15 %
Q4_2019	23 %	3 %	16 %	6 %	24 %	1 %	28 %

The information above means that most probably many of the prospective students did not necessarily visit the AMKoodari project website at all. The ones who did, had multiple ways for finding courses that interested them at their disposal. First, of course, just finding out what the offering was and reading the course descriptions or perusing the blog posts available, second, recommendation systems.

The recommendation systems were introduced mid-project, and the first feedback related to them were available after the third quarter of 2020. Below is a table indicating the number of users who gave feedback after a particular quarter, the percentage of respondents who used a recommender available on the AMKoodari website, and the percentage of those who found the recommender useful.

Table 2. Recommendation system use

	Number of respondents	% using a recommendation system	% of whom found it useful
Q2_2021	272	13 %	64 %
Q1_2021	148	16 %	75 %
Q4_2020	446	21 %	65 %
Q3_2020	232	24 %	62 %

As the percentage of the recommendation system use declined over time, it might indicate that the website visitors have learned of courses and their content from other sources already. Some may be returning to find more offering, having already found their path. Nevertheless, given that the percentage of users who found the recommendation system useful remains relatively stable and high, we are encouraged to develop these systems further.

In the project, we produced two tools for helping potential students in the course selection: one a simple decision-tree type selection tool, the other, a mobile app using AI methods in the guidance. In the following, we describe the functionalities of the two.

3.1 Decision-type tool

The first one, a simple decision-tree type tool in the AMKoodari website, is based on a set of seven questions, one for each module within AMKoodari. Based on the answers to these questions, a potential student receives a recommendation of courses (currently available) and topic areas that might suit them. The tool also suggests competences to gain based on the kinds of skills the job market is seeking.

3.2 Mobile application

The second one, a mobile app called AMKoodari (aka AI tutor within the project), was developed using both decision-tree-type technologies as well as AI methods. It was made available for free download both for Android and IOS users (respective approximate amounts of downloads during the project: 600 and 100).

After initially experimenting with a dataset containing enriched course descriptions, the mobile app team took EU's ESCO (European Skills, Competences, Qualifications and Occupations, https://ec.europa.eu/esco/portal/home) classifications as its dataset, and built a natural language AI model using Watson NLU. This model searches through the dataset looking for skills and calculates scores for them. The app also uses another natural language model based on Wikipedia which finds keywords wider than ESCO data. Additionally, the app uses an AI-based translation service to translate course descriptions.

In addition to these, the team built a natural language classifier based on anonymous feedback from AMKoodari students. This data was used to recommend AMKoodari modules using five questions. This feature was, however, removed from the app as it turned out that prospective students need more information on modules and that recommendation alone is not enough.

As regards data from the actual users of the app, there were not enough users to make any meaningful analyses. The data sources used were limited to course descriptions (enriched with information on skills), ESCO classification and occupations that were linked with AMKoodari courses and skills, and anonymous feedback from students. Despite this, the app project was able to experiment with multiple algorithms, and learn how to best use the technologies. Future development will need to focus on user experience, which, of course, is the most important feature of any app.

4 AI DEVELOPMENT FOR CURRICULA PURPOSES

The third AI-related tool was produced for the universities of applied sciences themselves for linking the curricula with the job market and for identifying course candidates to be added to course selection. We aim to further develop this tool so that it can also be used for helping students in their choice of studies.

The first phase of this project was data modelling: all the learning offering from the participating five universities of applied sciences were machine-read after which artificial intelligence (cognitive AI platform using natural language processing algorithms) was used to identify courses that relate to coding. Then, the solution was used to produce a real-time view into skills that are in high demand in this field (typically software development), how this demand is spread to different geographical areas, and what are the themes and potential clusters.

Once the data was analysed, we had visibility into courses, the competences they offered as well as to real-time demand of those skills. These could be sorted into lists, competence charts or separate documentation.

As a result, we had the competences related to modules listed, and in the first implementation (depicted below) we could link any module's specific skills into job openings in a designated geographical area, see where the job openings are, how many there are, and what the top ten jobs specifically are. Below is a screen shot of the first implementation.

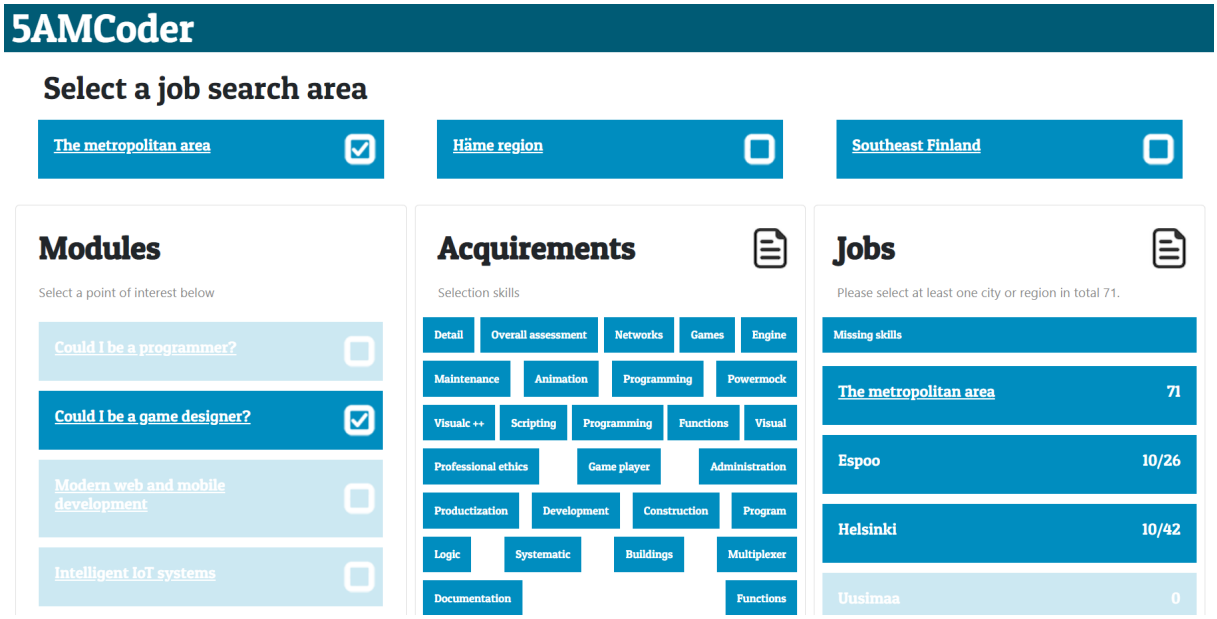

Figure 1. 5AMKoodari implementation (NB. Acquirements = Skills; the original is in Finnish; the titles are automatic Google translations)

In addition to the functionality described above, we could also see skills that were missing from our courses. Overall, the tool is very useful in verifying how well our course offering and the skills honed therein match the job market demand. We could also drill into the specific skill demands of job roles as the tool gives the actual job posting information of top ten jobs within that skill area.

When the first implementation was finished in March 2020, we could also see that offering free coding education was not in vain. At that point in time, there were altogether 12364 open jobs in the designated three geographical areas within the seven modules we had defined for the offering. The majority of the demand was focusing in Modern web and mobile development – 6191.

5 SUMMARY AND NEXT STEPS

While the development project continues until the end of 2021, we can already conclude that the project has been a success. Learners found our courses, and they also found AI tutor (the mobile app) and the course recommendation tool interesting. The Finnish Ministry of Education and Culture had set clear

targets as to the number of credits students need to accomplish, and we achieved those targets well ahead of time. It was also obvious that the learning offering met the needs of the world or work and businesses. As regards feedback on the solutions we developed, user feedback was positive overall, and potential students used recommendation systems especially when choosing their first courses.

In addition to succeeding in the development work, we found identifying the areas where we need to improve very meaningful. First, of course, we need to improve the usability of the solutions. Second, we need to learn more about data: what data to collect and in which format, how to make meaningful analyses of it, etc. The technologies already exist and we were able to use multiple AI methods, algorithms, decision-tree tools, and combinations of them – but what we need to learn more of is data.

Finally, a special note about AI ethics. As we develop solutions and apps which, for example, through recommendations give guidance on choices learners make that influence their lives, we must take into consideration the values that guide the development work. Developers of apps and other solutions cannot determine if the service that is developed is meaningful for the individual or not, nor can they determine if the choices artificial intelligence offers has consequences for the individual or not.

The usability of any solution entails that it must be able to offer personalized solutions for a learner. Producing personalized content is only possible if we have enough data of learners. The data used by AI must guarantee protection of privacy, learners must accept that her/his activity produces data which is gathered, and we must be able to guarantee that the data gathered depicts a phenomenon and is not biased or corrupt to begin with. We must be able to tell a user of a solution on what base a certain course has been recommended for her/him. In other words, the decision-making process of any AI solution must be transparent.

We are moving from degree centricity to competence centricity. Education is conceived as service and students' role is becoming that of a consumer. This transition poses a challenge for higher education institutions as we must develop both the offering and technologies related to them with the customers and their needs in mind.

Developing technology according to ethical principles is an enabler of continuous learning renewal.

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