Proceeding Paper

Forecasted Self: AI-Based Careerbot-Service Helping Students with Job Market Dynamics [†]

Asko Mononen [1,*] , Ari Alamäki [2], Janne Kauttonen [2], Aarne Klemetti [3], Anu Passi-Rauste [4] and Harri Ketamo [4]

1 Digital Living Lab, Laurea University of Applied Sciences, 02650 Espoo, Finland
2 Digital Services, Haaga-Helia University of Applied Sciences, 00520 Helsinki, Finland
3 School of ICT, Metropolia University of Applied Sciences, 02610 Espoo, Finland
4 HeadAI Ltd., 28130 Pori, Finland; anu.passi-rauste@headai.com (A.P.-R.); harri.ketamo@headai.com (H.K.)
* Correspondence: asko.mononen@laurea.fi; Tel.: +358-400-679-768
† Presented at the 9th International Conference on Time Series and Forecasting, Gran Canaria, Spain, 12–14 July 2023.

Abstract: In this article, we introduce an AI-enhanced study planning solution named Careerbot, which is a service designed to help students with their "forecasted self". We define a new term "forecasted self" to mean a future-oriented digital twin, where a student can explore several future selves equipped with new, acquired skills for projected future jobs. The future jobs domain here includes knowledge-work related jobs related to digitalization, emerging technologies, and Industry 4.0/Society 5.0.

Keywords: artificial intelligence; big data; career coaching; data visualization; forecasted self; Industry 4.0; job market intelligence; mydata; skills data; Society 5.0

1. Introduction

In this article, we introduce an AI-enhanced study planning solution named Careerbot, which is a service designed to help students with their "forecasted self". We define a new term "forecasted self" to mean a future-oriented digital twin, where a student can explore several future selves equipped with new, acquired skills for projected future jobs. We believe the use of this new term and approach will provide the benefits of understanding the following: (1) the essence of future orientation; (2) a holistic approach of soft skills and hard skills that are appreciated by employers; (3) the skill gap between current skills and the direction on which to focus skill acquisition, and (4) the ability to verbalize one's skills and competences in the concrete language used in job ads by employers (in contrast to academic jargon, for example). We also use the term skills data as the unifying factor among different actors and operations: "skills data describes people's skills, the competence needs of organisations, and the competence offerings of educational institutions. In practice, skills data can be found, for example, on employees' CVs, companies' job adverts, and course guides" [1].

We examine the adoption of artificial intelligence (AI) in three applied universities (3AMK) in Finland. More specifically, we analyse and discuss experiences regarding the educational AI-solution that assists higher education students by providing course suggestions, thesis topic trends, and job market data for their career and study planning. 3AMK is a strategic alliance among the three largest universities of applied sciences in Finland: Haaga-Helia, Laurea, and Metropolia (3amk.fi). 3AMK has approximately 34,000 students, 2000 staff, and 15 campuses in Helsinki, the capital region. In this paper, we conceptualize "forecasted self" based on the analysed experiences in designing and adopting the Careerbot AI-enhanced study planning service.

The adoption of AI is rapidly growing as a means to enhance students' personal or collaborative learning and study planning in higher education. The adoption of AI

provides new opportunities to develop study planning where AI can model and suggest competence profiles, needs, and requirements from real-time job market data. The prior literature on AI-enhanced learning and teaching shows that AI can create value for students and teachers, e.g., [2–4]. AI enables personalization, e.g., [5,6] which is an important requirement in improving and customizing learning for the special needs of each student. AI is also widely adopted for students' performance assessment, competence profiling and assessment, finding learning gaps, and predicting students' progress in the courses [7–9].

2. Background of Careerbot-Service of 3AMK in Finland

3AMK developed Careerbot-service to help their students to pursue their dream careers with the help of AI. The Careerbot-service can help 3AMK students to do the following:

(1)   Verbalize their skills with the help of AI (skills profile; current or "forecasted self" in the future);
(2)   Find jobs with their skills profiles (job market intelligence);
(3)   Find courses for skill development (upskilling, re-skilling);
(4)   Find theses/research topics, trends, and content (research intelligence).

Careerbot-service uses a language model based on AI, which has been trained with millions of news articles and with ESCO classification, for example. ESCO is the multilingual classification of European Skills, Competences, and Occupations. ESCO is part of the Europe 2020 strategy.

The data sources for Careerbot-service currently include the following:

(a)   Job market data in Finland (Työmarkkinatori, MOL, and Duunitori/employment services) with more than 400,000 job ads on a yearly basis, since January 2018;
(b)   3AMK course data for all 15,000 courses;
(c)   Theseus—A thesis database with more than 120,000 theses available from Finland, since 2010;
(d)   Global article database, a directory of open access journals, DOAJ, with more than 8.6 million articles.

The language model, foresight data products (curriculum data, labor market data, investment data, and research papers), and the AI behind the service, Graphmind, are powered by the Finnish tech company HeadAI Ltd, from Pori, Finland. Graphmind is a graph machine-learning-based semantic computing framework accessible via REST-API. The usage of API allows Careerbot-service the flexibility to use any AI model to expand its functionality.

The basic operations behind the framework are the following:

(i)   Building a digital twin (personal, curriculum, and scenarios);
(ii)   Comparing two digital twins against each other to show similarities and gaps;
(iii)   Recommending interventions from the third digital twin to bridge the gap.

In addition to the 3AMK students, the 3AMK staff have access to service. Lecturers and content creators can ensure their content is up to date. RDI staff can search for research ideas or prior research articles for supporting the new externally funded RDI projects. In addition, career coaching can use Careerbot-service in their career counseling for students, backing up visual CVs with data and vocabulary known in the work sector.

Figure 1 below demonstrates one example map, a zoomable snapshot of the most important hard and soft skills in ICT in the Helsinki region, with data from the previous cut-off date. The clusters below in the bubble chart (a) represent the same data in the top lists that are shown in (b), namely the 15 largest hits in order of relevance. There are currently 19 ready-made example maps in Finnish and English: 13 job market maps and 6 curriculum maps. The maps are updated every 1–2 months, which seems to be frequent enough to see the current changes. The same functionality can visualize the students' skills profile data, so they can attach the image to their CVs, for example. These maps leverage the semantic language model and its graphical representation of terms. This graph

is visualized using a multi-body particle simulation model to represent the graph as a collection of 2D non-overlapping disks. The algorithm pushes the most connected terms towards the center, while the less connected terms stay near the boundary. The clustering is computed using a weighted community detection algorithm [10].

**Most important hard skills and soft skills in Helsinki, Espoo, Vantaa region in 2023-2 limited to theme ICT (EN)**
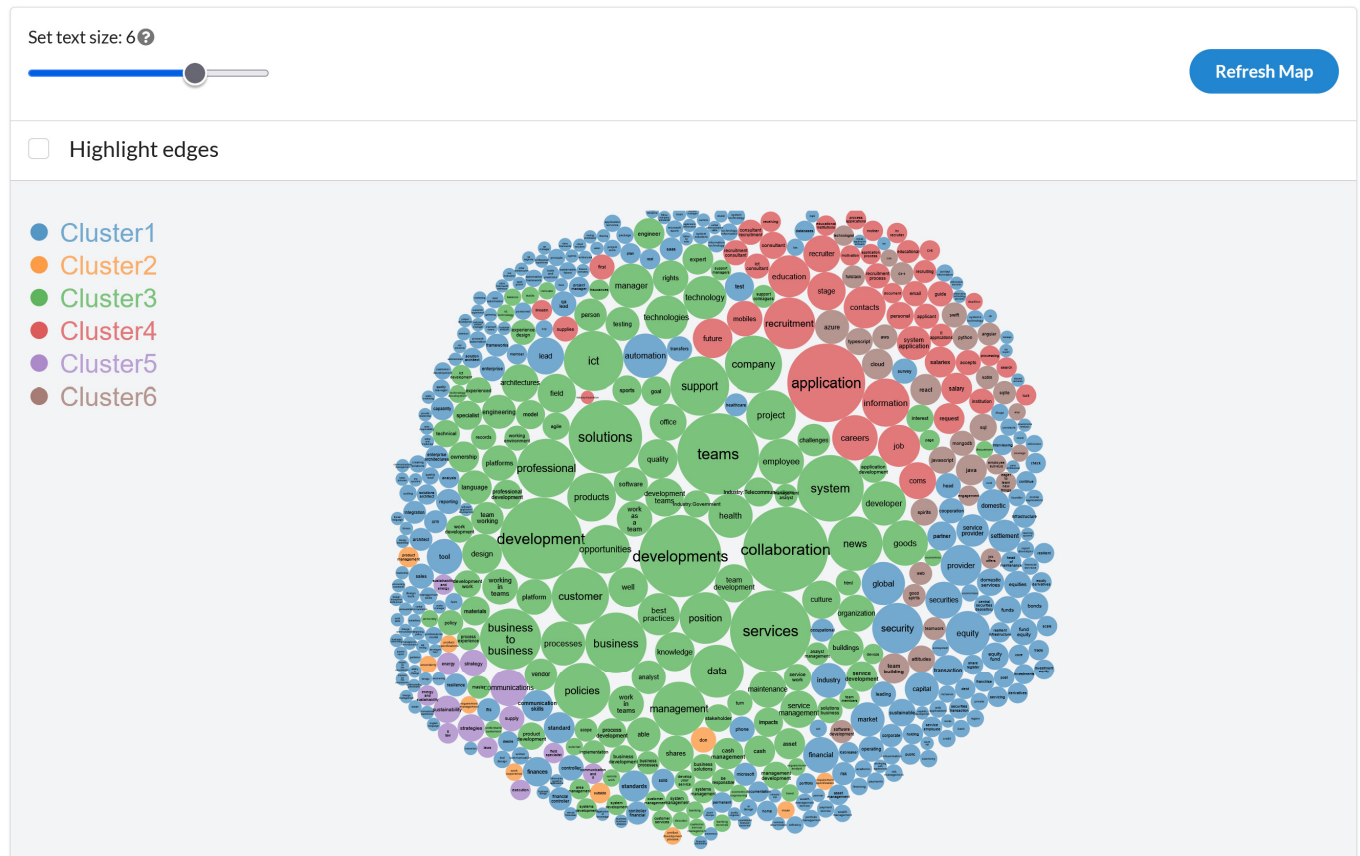
(**a**)

Figure 1. *Cont.*

| Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
security 20	don 9.9	collaboration 33.5	application 30.7	communications 14.6	azure 13.4
equity 17.5	outside 8	development 32.4	recruitment 20.4	sustainability 10.7	team_building 12.2
automation 17.5	product_management 8	developments 32.4	information 18.8	strategies 10.7	cloud 12.2
global 17	mean 6.8	teams 32.1	careers 17.9	strategy 10.7	react 12.2
provider 16.1	uncertainty 6.8	services 31.9	job 16.6	supply 9.9	java 12.2
securities 14.6	product_development_process 6.8	solutions 29	contacts 16.6	energy 9	typescript 10.7
lead 14.6	requirement_specification 6.8	system 26.2	education 16.6	energy_and_sustainability 8	spirits 10.7
industry 14	requirement_management 6.8	business_to_business 24.1	future 15.6	execution 8	attitudes 10.7
financial 14	product_specifications 6.8	business 24.1	stage 15.1	it_law 8	sql 10.7
tool 14	work_experience 6.8	ict 23.5	coms 14.6	laws 8	javascript 10.7
capital 13.4		professional 23.2	recruiter 14.6	communication_and_it 8	mongodb 9.9
market 13.4		support 23.2	mobiles 14	field_specialist 8	python 9.9
service_provider 12.8		company 22.5	system_application 13.4	sustainability_and_energy 8	swift 9.9
settlement 12.8		customer 22.5	request 12.2		aws 9.9
domestic 12.8		policies 22.2	salary 12.2		web 9

(**b**)

Figure 1. Zoomable example map in Careerbot-service: (**a**) represented as clusters and (**b**) same data in top 15 lists, with color-coded clusters.

Figure 2a depicts trends from the global DOAJ article database (doaj.org), with the search words artificial intelligence, machine learning, and big data. The data are updated currently until December 2021, so the year 2023 is denoted as zero. From the graph, we can conclude that of the search results, "machine learning" had been trending clearly above "artificial intelligence" and "big data" in 2021. The prediction tab is used for testing; it calculates the following years based on the historical data and fits a B-spline approximation for the data [11]. Figure 2b lists the search results page below the graph (Figure 2a), where the individual papers can be opened with a mouse click.
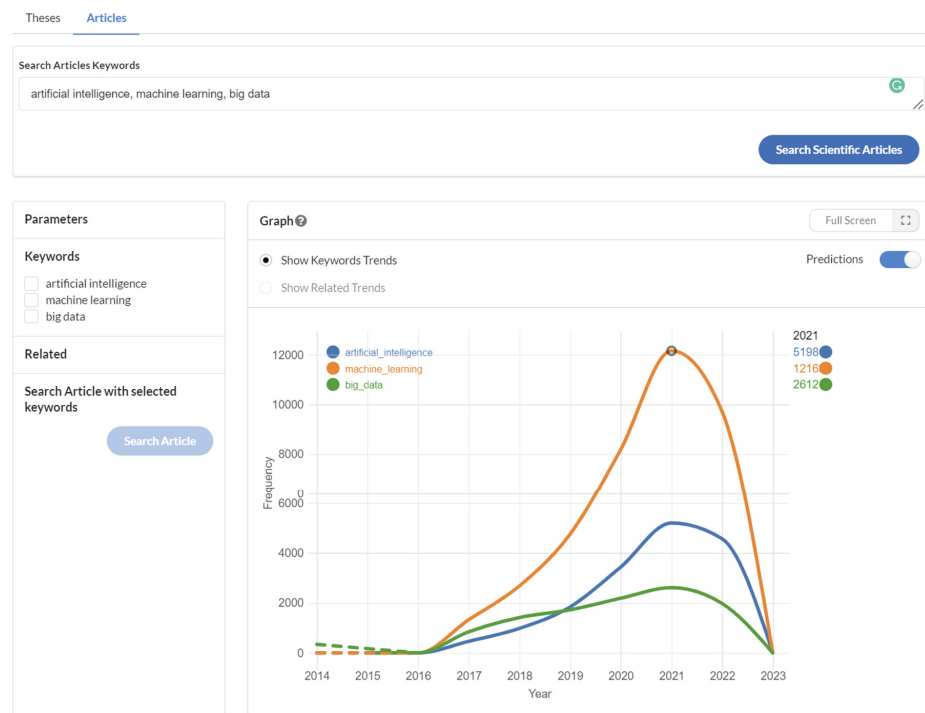
(**a**)
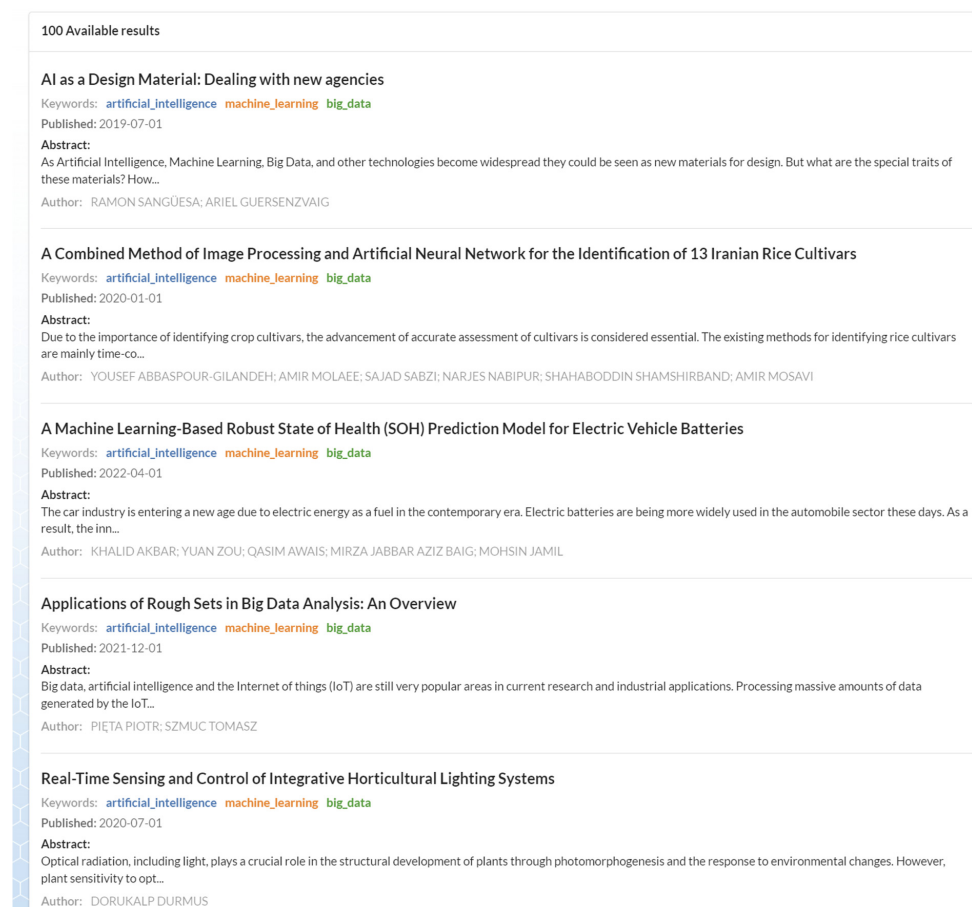
(**b**)

Figure 2. (**a**) Searching global DOAJ article database, with trends shown. (**b**) Searching global DOAJ article database, search results page. Source: Careerbot-Service.

3. Conclusions

We contribute to the discussion of AI-enhanced learning and teaching by conceptualizing "forecasted self", a novel concept for the digital twin approach in the context of education.

"Forecasted self" is defined as a future-oriented digital twin, which allows students to explore several future selves equipped with new, acquired skills for projected future jobs of Society 5.0.

We also use the term skills data as the unifying factor among different actors and operations. The idea is to combine all the relevant distributed data sources, including internal data, mydata, and public/open data. This approach supports the EU skills data space initiative by mapping, matching, and forecasting skill-based data.

3AMK developed and adopted an AI-enhanced study planning service named Careerbot for helping higher education students with their "forecasted self". Via API, the service can leverage any AI model running on the server or in the cloud.

The adoption of AI is rapidly growing in higher education and provides new opportunities to develop study planning, learning and teaching, including personalization and customizing learning for the individual needs of each student. Students need to be able to create their own digital competence profile (digital twin), for example, with the help of a Careerbot AI solution that simulates the competence requirements of the up-to-date and current job market data.

Author Contributions: Conceptualization & methodology: A.M. and J.K.; validation J.K., H.K. and A.P.-R.; visualization A.M.; writing—original draft preparation A.M., J.K. and H.K.; review and editing A.M., J.K., A.K., A.A. and A.P.-R.; project administration A.M. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data from Careerbot-service is currently available only for 3AMK students and staff.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Technology Industries of Finland. Skills Data Playbook. 2022. Available online: https://teknologiateollisuus.fi/sites/default/files/inline-files/Osaamisdatan-Playbook{-}{-}ENG-03-aukeamittain.pdf (accessed on 23 March 2023).
2. Mononen, A.; Alamäki, A.; Kauttonen, J.; Klemetti, A.; Räsänen, E. Adopting AI-enhanced chat for personalising student services in higher education. In Proceedings of the AINL 2020 Artificial Intelligence and Natural Language Conference, Online, 5–7 July 2020.
3. Popenici, S.A.; Kerr, S. Exploring the impact of artificial intelligence on teaching and learning in higher education. *Res. Pract. Technol. Enhanc. Learn.* **2017**, *12*, 10–11. [CrossRef] [PubMed]
4. Renz, A.; Krishnaraja, S.; Gronau, E. Demystification of artificial intelligence in education–How much AI is really in the educational technology? *Int. J. Learn. Anal. Artif. Intell. Educ. (Ijai)* **2020**, *2*, 4–30. [CrossRef]
5. Chassignol, M.; Khoroshavin, A.; Klimova, A.; Bilyatdinova, A. Artificial intelligence trends in education: A narrative overview. *Procedia Comput. Sci.* **2018**, *136*, 16–24. [CrossRef]
6. Tiihonen, J.; Felfernig, A. An introduction to personalization and mass customization. *J. Intell. Inf. Syst.* **2017**, *49*, 1–7. [CrossRef]
7. Costa, E.B.; Fonseca, B.; Santana, M.A.; de Araújo, F.F.; Rego, J. Evaluating the effectiveness of educational data mining techniques for early prediction of students' academic failure in introductory programming courses. *Comput. Hum. Behav.* **2017**, *73*, 247–256. [CrossRef]
8. Ketamo, H.; Moisio, A.; Passi-Rauste, A.; Alamäki, A. Mapping the future curriculum: Adopting artificial intelligence and analytics in forecasting competence needs. In Proceedings of the 10th European Conference on Intangibles and Intellectual Capital ECIIC 2019, Chieti-Pescara, Italy, 23–24 May 2019; Sargiacom, M., Ed.; pp. 144–153.
9. Yang, F.; Li, F.W. Study on student performance estimation, student progress analysis, and student potential prediction based on data mining. *Comput. Educ.* **2018**, *123*, 97–108. [CrossRef]

10. Clauset, A.; Newman, M.E.; Moore, C. Finding community structure in very large networks. *Phys. Rev. E* **2004**, *70*, 066111. [CrossRef] [PubMed]
11. Unser, M.; Aldroubi, A.; Eden, M. On the asymptotic convergence of B-spline wavelets to Gabor functions. *IEEE Trans. Inf. Theory* **1992**, *38*, 864–872. [CrossRef]