Skills Matching for a Greener Industry 4.0-A Literature Review

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Skills Matching for a Greener Industry 4.0 – A Literature Review

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Abstract. Manufacturing industry has historically had a very high leverage on environmental impact. Therefore, it is urgent to identify how the industry and its employees can contribute to change towards a sustainable society. Industry leaders need to enable their employees to create sustainable solutions, using technologies rising in industry 4.0. However, nowadays there are also critical discussions about whether this trend has reached our workplace settings in a satisfactory way. Namely, there is a growing skill gap among employees in manufacturing industries causing a lack of capability to match skill needs for fast technological development and requirements on sustainability. The resulting mismatch of technical and managerial knowledge and experience will critically impact companies in competitive markets. Despite a vast range of educational initiatives available on the global market, less employees than needed are developing new skills. A smart matching process to strategically support employees in their learning paths, by matching them to new relevant skills and matching those skills to learning activities, could bridge the widespread skill gap and address challenges e.g., motivation to learn. This study reviews existing research on functional matching processes for individually tailored learning and upskilling paths for employees that need to develop skills in industry. The study's result maps out parts in a matching system and identifies the existing gap in literature.

Keywords. Matching, skill gap, upskilling, industry 4.0, green skills.

1. Introduction

There is a growing demand for skills necessary to master the fast technological development of Industry 4.0 [1]. Further complicating the situation is the accelerated impact of industry on the climate, resulting in major needs for sustainability efforts. Therefore, the United Nations Industrial Development Organization [2] has defined green tasks as an industrial priority, requiring increased sustainability skills among employees. This mismatch between technical and managerial knowledge and experience may have critical impact on a company in a competitive market. It is urgent to identify how the environmental impact can be minimized rapidly and how employees can contribute to that change. Namely, to ensure inclusive and equitable quality in digital transformation empowering employees to take control of their agency [3].

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In 2020, the World Economic Forum [1] claimed that more than 70% of the global workforce will need to enhance their skills by 2025, including skills on environmental sustainability.

The report suggests that 44% of the skills will change, also assuming many of these new skills will have digital and environmental content. Despite a vast range of educational initiatives available on the global market, many employees don't use the resources. In a survey from 2021 among 15000 adults from the US, only 21% of respondents working in production said they had done upskilling in the last 12 months that was provided by their employer [4]. The United Nations' Agenda 2030 with its 17 goals provides a responsibility framework for countries to fight poverty, protect the environment, and improve life quality in general for generations to come. In Sweden, a high percentage of carbon emissions emanate from the industrial sector. Sweden addresses this challenge by establishing a goal to become climate neutral until 2045 [5]. Climate impacts from industry must be drastically lowered to accomplish this tough goal. Many companies also realize that minimizing future negative effects is not enough, there is also a need to compensate for past impact, when old knowledge and old technologies were not adequately tuned to the needs of the climate. Therefore, industry leaders need to find new technologies, new knowledge, and new skills which can enable their employees to implement sustainable solutions that minimizes company carbon footprints and improves sustainability indicators.

Green employee skills meet new requirements but may evoke conflicts of interests and ethical challenges faced by people working in the industrial sector. Many industrial settings are still far from implementation of innovative practices to support employees to be agents of change through active participation and promoting their green skills. The matching between skill needs and employees to be upskilled thus becomes crucial to the necessary change towards a climate-neutral industry.

The primary aim of this paper is to review skill-matching and skill-mapping initiatives essential to bridge skill gaps. The secondary aim is to begin addressing how climate challenges can drive demands for learning, incentivising courses for upskilling in the commercial and governmental education market. There may be a lack of matching tools to identify the right learning for the right employees. Such a matching process could guide individual workers along an appropriate learning pathway. By investing time and resources in life-long learning for their employees, companies may be both sustainable and profitable in the long term.

This study will review how matching can be used in industrial employees' professional learning to accelarate green skills development. Three research questions have been identified. The first question is to understand how skill needs can be matched to education activities. The second question is how matching can be used to close skill gaps in industry. The third question focuses on green skills specifically and pinpoints how matching can be applied for industry's needs.

2. Background

Matching is a generic term, widely used in different contexts. The Cambridge dictionary [6] defines the verb to match in different ways, one is "to choose someone or something that is suitable for a particular person, activity, or purpose" and another is the definition of matching something to something as "to find something that is the same as something else, or goes well with it." An example: *"We can help you match the person to the job."*.

Matching has many areas where it's used today, from matching therapists and clients [7], to dating-sites that match people who could be a good fit for each other, and music streaming services that match people with music they could like.

In this paper, this definition of matching is used in the context of **finding suitable learning activities and paths for industry employees that need upskilling**. Matching is here a concept describing the link between a demand and supply, identifying the best suitable object on the supply side for one object of the demand side. Matching could be done by humans following rules based on science and experience, or it could be done by an algorithm using rules to make an automated matching.

Industrial digitalisation is very broad, but the specific *Industry 4.0* initiative was launched in Germany during the Hannover Fair in 2011, marking a paradigm shift in industry. Before, industry had faced three industrial revolutions through history, bringing major changes with them for the work in the factories. The fourth industrial revolution brings along the use of cyber-physical systems to create the Internet of Things and the possibility to control and improve decision-making in the production process [8]. The transformation requires the use of new technologies, such as additive manufacturing, connectivity, artificial intelligence, and collaborative robots.

A recent initiative by the European Commission (EC) describes the next paradigm, *Industry 5.0* [9] which fully exploits the technical advantages of Industry 4.0 and enhances the value propositions of sustainability, resilience and a human-centredness. The EC wants to spend tax-payer money to increasingly promote greener, more competitive, and socially acceptable European industries, especially after the COVID19-pandemic. The industry 5.0 concept incorporates development and implementation of new skills and necessity for re- and upskilling.

The EC defines *skills*, *knowledge and competences* to have a common understanding. A **Skill** is defined as the "ability to apply knowledge and use know-how to complete tasks and solve problems.". **Knowledge** is defined as the "outcome of the assimilation of information through learning." And as "the body of facts, principles, theories and practices that is related to a field of work or study.". **Competence** is defined as the "ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development.". [10]

This paper uses the term skill, as it has become the most commonly used term. However, the term *skill gap* is used when the existing skills don't correspond to the skills needed to be successful in specific tasks to reach certain goals. Industry employees need to get used to a new work life, where continuous learning is a natural part of being able to keep being valuable for the organization and for society.

A skill gap can be used to see what somebody is missing and to set goals and frequently there will be skill gaps that can be used to set new goals.

In the last years, the words *upskill* and *reskill* have been used more frequently. These are terms to describe skills development of employees. Upskilling means to learn new skills, in comparison to reskilling which means to learn new skills in order to be able to do a different job. While a worker that needs upskilling may stay in their current job, an employee that needs reskilling might face major changes in their occupation. [9]

When it comes to *green jobs* or *green skills*, there are still different understandings of what it means. Surely, there is a widely assent that green occupations are needed. As the World Economic Forum underlines [11], jobs in the green sector aren't so many, but they grow much faster than jobs in other sectors. The OECD [12] defined green growth as "fostering economic growth and development while ensuring

that natural assets continue to provide the resources and environmental services on which our well-being relies.". For green growth of businesses, employees need certain skills.

According to the European Commission [13], green jobs are "all jobs that depend on the environment or are created, substituted, or redefined (in terms of skill sets, work methods, profiles generated, etc.) in the transition process towards a greener economy.". An earlier description of green jobs [14] is that green jobs are "work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity, reduce energy, materials, and water consumption through high efficiency strategies, de-carbonize the economy, and minimize or altogether avoid generation of all forms of waste and pollution.". Thus, in this study, green skills are used in the sense of skills that are needed to support the green growth and needed to do green jobs.

3. Literature review and method

This paper focuses on matching as a way to bridge the skill gap. Green growth has higher importance than ever and therefore, green skills are needed. There is a growing skill gap in industry, even though there are a lot of training opportunities on the market. There is a high interest in the future of work in industry, and a growing number of scientific papers.

A five-step literature review [15] was conducted in the reference databases *Google Scholar* and *Scopus* in September 2021. These databases were selected because they show a high coverage of industry-related topics, compared to *Web of Science*. The following steps were taken during the review process: **Define, Search, Select, Analyse, and Present**. Step one defined criteria of inclusion and exclusion of papers. The search included papers about matching between employees, skills, trends and jobs in different combinations. Review papers might cover several matching parts or only one. All industries were included. Papers about skills mismatches considering people in search for jobs were not included. These mismatches relates to job markets as a whole and are about filling companies' demand for employees, and people's need for jobs. Journal papers, conference papers, and book chapters were included. The time range for publications was 2000-2021. Fields of research included were: data analysis and matching, learning, and humans in industry.

The selected search terms were: **Matching, Skill gap, Industry, Reskill, Upskill, and Industry 4.0**. A search in Google Scholar showed 1720 results, 60 of those were selected by title and scanned according to defined requirements. Eight of the scanned results were selected and included in the literature review. The search in *Scopus* and *Web of Science* didn't show any results. A complementary search removing the keywords *reskill* and *upskill* showed additional results in Scopus but led to less useful results in other domains. For the analysis step, focus was on answering the research questions by finding and comparing definitions; selected focus areas; which part of the matching process was regarde; what databases were used; and what target groups were included. This was structured in an excel-sheet and in presenting the results, graphics were created.

The first search did not include any papers that focused on green skills development, but rather skills development for the transformation to industry 4.0. Another search was needed to distinguish if there are differences to take into consideration when focusing on

green skills. Therefore, a search on Google Scholar was made with the search terms: green skills, green jobs, matching.

4. Results

The data of the literature review is presented according to the three research questions.

4.1. Findings for question 1: How can skill needs be matched to education activities?

To account for a general understanding about how peoples' skill needs can be matched to education activities, the different studies were organized according to different parts of matching, to see what parts are needed and what had to be matched with what. Since the end goal was to match an employee with education activities, it had to become clear which steps had to be taken in between. It's necessary to first identify the skill gap in relevance to the employee's job profile, and then create suggestions for training. Eight studies that deal with the creation of one or several parts of matching to close the skill gap in industry, were categorized according to which part of matching they deal with. The matching can be described as a system with the subsystems trends, skills, job profiles, employee, task, machine and training item, as synthesized from the scanned papers [16], [17], [18], [19], [20], [21], [22] and [23]. These sub-systems and the matching between them occurred in the papers, sometimes differently, e.g., learning program instead of training [16]. Also, according to [17] "skills" could be derived into skills, knowledge and competences. To simplify, these were summarized as "skills" in the holistic perspective. Figure 1 shows the different objects in the system.

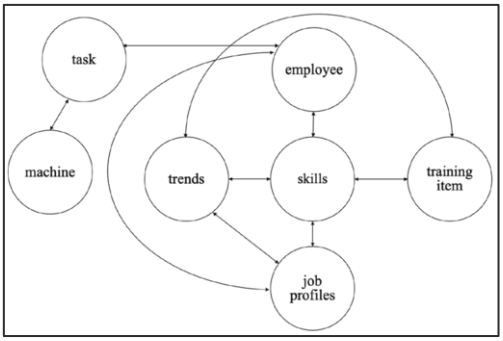

Figure 1. Objects in a matching system.

Pontes et al. [16] included several parts of the matching suggesting mathematical solutions for matching trends to job profiles, and matching new skills needed with training programs. In their solution they suggested that the users of the system choose by themselves which trends and affected job profiles are relevant in their business context, after they see the system's suggestions on trends and affected job profiles. The users also need to decide by themselves which ones from the suggested skills they need upskilling in. After deciding which skills need upskilling, training programs are suggested or, in case no training programs about these skills are available, education providers are contacted to inform them about the demand.

Ansari et al. [17] focused on the interaction of humans and machines and how to match tasks to both humans and machines. The socio-technical system described in this paper deals with the tasks that are derived in knowledge, skills and competences and thereafter the system looks for the best-fit jobholder. The system also includes the matching of new skills to a person, making suggestions for learning items. Aiming at creating an optimal level of collaboration between human and machine, this study proposed strategies for change management. The study referred to the Job-Know ontology, a model with a supply space, a demand space, and a matching space.[17]

The Job-Know ontology was used earlier by Khobreh et al. [19] and the mismatch between jobs and knowledge, skills and competences (KSC) is described in four different states: gap, shortage, surplus and obsolete. Their matching between jobs and new skills to learn, the matching between skills and training and the matching between trends and new learning items was described and modelled. As in [17], this study investigated the role of both humans and machines and found ways of monitoring their individual learning curves. The article proposed a learning assistance system that recommends relevant learning items, according to the employee's set of KSC and their productivity curve. The authors created a model with three spaces, namely a **demand space**, a **supply space** and a **matching space**. The demand space consists of the job, task, job description, job specification and job-KSC. The supply space includes the learning items. To see if the KSCs in the supply space and the required KSCs are in balance, The matching space in between those two spaces is the link between supply and demand.

A study by Solinas et al. [18] focused matching trends and job profiles, and trends and skills. Here, the target is to identify how to use text-mining technology to decide if a job profile is ready for the new workplace in the industry 4.0 era, or not. In addition, this study goes deeper into the text-mining technology Named Entity Recognition (NER), and a new way of extracting soft skills from text was created.

De Mark and Kozyrev [20] base their matching on a skills-based architecture. In their approach, jobs are matched with new skills, skills with training items, trends with new training items, people and job profiles, and people with new skills. The authors came from a university perspective, and their goal was to identify new needed skills for specific job roles and create learning pathways for the students at the university that lead them to job roles that companies request. The authors created their own skills library to use skill tags in the university program's curriculum and to be able to analyse how close the program's skills goals are to the market needs. The university started a collaboration between education, industry and government to start the Open Skills Network (OSN).

Another study, by Fareri et al. [21], focused on job profiles and how text-mining technology can be used to make a differentiation between the skills of job profiles that are ready for the industry 4.0 world, and those that are not. In that way, the study looks at matching trends and job profiles and matching trends and skills. This is applied to a case study and meta-data is collected to improve the algorithm.

Chen and Yang [22] highlighted the possibility of using AI for personalized education, to individualize learning. They also proposed the use of AI to match people with new skills to meet the needs of Industry 4.0. No concrete solution was presented but rather a general description of what could be done.

4.2. Findings question 2: How could matching help closing the skill gap in industry?

The literature review shows different reasons mentioned why the urge to close the skill gap in industry exists and why matching could be a solution. Several studies evaluate their idea through cases. All studies are present solutions for the industry sector.

Chen et al. [22] sees an urge for a solution to bridge the skill gap because AI and automation might take millions of jobs and the increasing skill gap is the reason why people's jobs are in danger. Ra et al. [23] sees challenges in the "technological advancement, shifting demographics and labor force, extended life expectancy and careers, and the covid-19 pandemic.". [16] sees industry 4.0 and the disruptive technologies of the new era as the reason for the change in skill set, leading to a rise of high-skilled activities, and a decrease of low-skilled activities. Also [17] sees industry 4.0 as the main reason for a need to develop skills, because of the shifting job profiles and the increase of human-robot collaboration. [18] sees the fourth industrial revolution having a big impact on the work in industry, bringing many jobs at risk to disappear, but at the same time an opportunity to find human value in other things than routine tasks. In [19], the authors see the shift towards industry 4.0 and therefore a need to increase learning, in specific, the focus lies on the productivity of learning. Both humans and machines are viewed as a learning workforce. They see learning as a lifelong process. Since [20] takes the perspective of students at university, they discuss matching as a possibility to increase their students' employability in the changing industry. They also see matching and skill-based hiring as an opportunity to give students with different socio-economic backgrounds the same possibilities on the job market. [21] sees matching as an opportunity to define the impact that industry 4.0 has on job profiles.

Several international databases contain job profiles and skills needed in industry. In some studies, the use of existing databases is realized. The database O*NET, by the US department of labor, is used by [18], [20] and [21]. The ESCO database by the European Commission is used by [18] and [21]. Those two databases are amongst the most analyzed databases for skills and jobs. [18] makes a deeper analysis of several databases since the focus of this study is the use of text-mining technology to extract information of the databases to see if a job is industry 4.0 ready or not. [16] creates their own database, continuously updated by experts and by other databases, such as LinkedIn and Glassdoor. Ansari et al. [17] also use their own databases, split in a personal characteristics database and a technology database.

The matching solutions in the studies are intended to be used by different people or groups in industry. Table 1 shows how the different studies and papers target their solution and who would use their matching tools.

Table 1. Target groups that matching solutions are addressed to.

Paper	Target group					
	Employer	**Human resources**	**Educator**	**Institution**	**Policy maker**	**Individual/ student**
[16]	X	X	X			
[18]		X	X		X	
[20]	X			X		X
[21]		X				
[22]	X				X	X
[23]					X	

As illustrated in table 1, [16] address their solution to companies from public or private sector, human resources managers and educators. [18] want their solution to be used by human resources, policy makers and educators. [20] claim that their solution could be used by students, institutions, employers and the economy in general. [21] see their solution as a tool for human resources. [22] direct their proposal towards employers, individuals and policy makers. In their message, [23] focuses on policy makers. The target group of [17] and [19] is not clear, but their tool matches jobholders and machines to tasks and could be used by different people in industry.

To summarize, the studies show a large variety of reasons for why it is important to find solutions to close the skill gap. The papers suggest different people in industry that should be involved in closing the skill gap. To build a system for industry, some databases are possible to use, since they contain industry skills and job profiles.

4.3. Findings question 3: How can matching be used to meet the need for green skills development in industry?

After stating the findings about matching and how this can be used to bridge the skill gap in industry, question 3 is focused on how matching can help industry to develop green skills. The approach was to capture the difference between green and non-green skills in literature and assess its impact on matching. Since the first literature search didn't mention any green skills, this question was answered by a complementary search query, aiming at finding any characteristics in green skills that differ from non-green skills.

As claimd by [24], no studies have been made about the correlation between green technologies and skills which is why they wanted to investigate green jobs in industry and how they differ from non-green jobs. In this study, focus lies on job profiles and how the related skills differ. The key outcome of their study was that people doing green jobs need skills of a significantly higher abstraction level. They also require more work experience, more on-the-job training, and higher education than those who have non-green jobs. In order to increase the employees' green skills, the authors [24] propose learning-by-doing activities. [25] claims that during the transition towards green growth, the principles are the same as during the industrial revolution. There is a need for closing the skill gap of green skills, and "governments should partner with industry and employers" [25]. In [26], the authors come to the conclusion that green jobs are more diverse in their skill requirements, "both with respect to the sophistication of the skills required and their degree of novelty." [26]. They also claim that the skill gap connected to green growth might be a result of "failings in education and training and reflect long-standing issues such as lack of incentives for employers to invest in developing the transferable skills of their workforces" [26]. The International Labour Office [27] states that the green transformation will not only change existing jobs but also create new ones. They see the skill gap hindering a green growth, and suggest the following solutions: "social dialogue among all stakeholders to define skills and education policies; a combination of top-down and bottom-up approaches to better reflect training provision needs; and public-private partnerships for skills and capacity development." [27]. The "match of demand and supply of skills"[28], lifelong learning, reskilling of workers, enhancing policies to develop skills are mentioned as parts of reaching the goal of staying productive and creating green skills.

5. Discussion

As mentioned in the result section, several studies propose matching as a solution to bridge the skill gap in industry. These studies have different approaches, dealing with different parts of matching. In this limited literature review, papers dealing with mismatches in the labor market, that try to match unemployed people with jobs, are excluded. Also, papers about matching within other fields than industry are not included, since the keywords for the literature review were chosen to focus on the use of matching to close the current skill gap in industry. In addition, the term matching was used and it could be relevant to investigate in the future if others have used other terms for the same thing.

This study is a first step and starting point for deeper investigations about green aspects of industry and how to develop necessary skills. The used method led to a narrow selection of literature focused on skill development in industry using matching. A gap in literature could be identified, i.e. none of the papers deal with concrete criteria that are important when matching an individual to tasks, skills, and a learning item. Further, a lack of literature was found in the assessment of value of the matching, i.e. to see if a match was good or not. At the same time, a broader literature study would have been helpful in understanding the concept of matching more in general and see how this could be transferred to the skill gap challenge.

One goal was to find if matching could be used to help closing the skill gap. The identified studies, [16], [17], [18], [19], [20], [21], [22], and [23], support the hypothesis that matching would theoretically help to close the skill gap. Since none of the studies identified were based on empirical studies, there is no evidence that a matching process in the way that it is proposed, really works. However, findings suggest in several ways, how the process of guiding companies, policy makers, educators, human resources, institutions, and individuals in the transformation towards industry 4.0, could be realized.

When understanding the meaning of matching, both [17] and [19] visualize their views very clear. For them, matching happens in a “matching space” in-between two spaces, i.e. the “supply space” and the “demand space”. The demand is in this matching the industry, the employees that need to learn new skills. On the other side, there is the supply space with the learning programs. They also describe mathematically, how objects in the spaces are related to each other. Their illustration could be used in the other parts of the matching process to understand what is to be matched with what.

Pontes et al. [16] show the most holistic perspective regarding the first research question in this paper. Even if the learner has some decisions to make along the process, e.g. deciding which trends fit to their business context, the authors of this paper describe the whole matching process and its steps, and the mathematical ground, from a learner, over finding the right new skills to learn and matches the learner to learning programs. The results from [16] have not previously been described in similar studies, covering the holistic picture of closing the skill gap in industry by guiding the learner through matching them to skills and learning items.

One unanticipated finding was that both [17] and [19] match a task to both humans and machines, to find the best fit job holder. This is an interesting thought and solution, because it takes into consideration that industry consists of both humans and machines and tasks may in some cases fit humans better than machines, and the other way round.

However, there are different sub-systems in the holistic picture of the matching and each paper delivers value that would help if a matching system like this was to be built in the future. Starting with what database could be used to train and maintain the system,

the studies have different approaches. The database O*NET is used in three studies, this data is relatively easy applicable and open for use. This applies for the ESCO database as well, used by two studies reviewed in this paper. When regarding the whole matching process, a combination of existing databases and an own database like in [16] makes sense. There are several parts in the matching that need and produce data. Thus, it makes sense to have a system that develops and learns over time. Therefore, an own database seems important, to be able to get feedback from the system and save it in the database. Surprisingly, the discussion of a feedback loop only comes up in [17], who propose the implementation of a feedback loop for their future work.

This feedback loop could help them gain empirical data and improve the system over time which seems very important if the system is to be used in a real-world context.

Another technique discussed by some papers is filtering trends out of big databases automatically. [18] proposes solutions how to use text-mining technologies to distinguish if jobs are industry 4.0-ready or not. If the matching process is to be automized, this is an important part to take into consideration and it should be further investigated, what machine learning technologies could be beneficial. [18] delivers proposals on how text-mining can be used to match trends to jobs, but their technique could also be used in other parts of the process, such as in the matching of learning items and skills to learn, extracting information of the learning item that are necessary to distinguish if a course is suitable to get matched to a specific skill.

It is important to discuss requirements on the objects in the databases, to be able to match them. One of these are the learning items that are matched to the new skills to learn. [16] speaks about whole training programs, including more or less of the needed skills. A training program seems likely to be less dynamic and harder to match, since in many occasions, it won't be a 100% match, a whole training program might contain parts that are unnecessary or missing some learning content that would be needed.

One of the major questions emerging from this discussion is the decision-making of the matching system and the humans. In [16], even though the whole matching process seems automated, a lot of decisions are taken by the learner. This is an interesting discussion, and might need further study, but it could increase motivation of the learner in the system, if they feel that they can have an impact on their learning and be part of the decision-making. On the other hand, not all employees might know what is relevant for them or their business, and decision-making could be quite susceptible.

This leads to another question that leaves space for further investigations. The humans in the system that are matched, but also the ones in the surroundings play different roles. The proposed solutions in the different studies are directed to different persons or groups and it would be interesting to find out the impact the choice of responsibility has on the main question of bridging the skill gap. The learners themselves play important roles, because it is they who have to upskill. Even so, only two of the studies ([20] and [22]) focus on the individual. For them, the starting point is a human who finds themselves in a changing environment and the system helps them to find their way. Of course, the other players in the system are important in supporting the learner, but how exactly should be investigated in future studies.

Surprisingly, none of the scanned papers on matching includes green skills development. Nor do they mention it, even though green growth is more urgent than ever. The scanned papers all do see industry 4.0 and some the covid-19 pandemic as reasons for a need of upskilling and reskilling accelerations. Even after scanning the proposed future work of the studies, no need of green skills development is mentioned. This is important to work on in future studies, since industry needs to become green.

This paper aims to highlight guided learning, through matching and identifying research opportunities. To sum up, the following topics need more investigations: matching criterias, matching assessments, green skills development, learners' roles and their environment, the benefits of matching. For these topics it would be important to have more empirical data.

There is no reason to think that matching of green skills differs from matching of non-green skills. Further empirical studies are be needed to find relevant answers for this. Further studies with more focus on empirical data from a test group should be done to investigate practically how matching can be implemented.

The fundamental questions related to this area are as follows: What is the interplay of individual and collective dimensions of professional learning in a variety of industrial contexts? What needs to be understood in order to design support for green skill development in professional learning? What benefits does a matching system have in this context?

Responding to the outcomes of this study, we would like to continue investigating matching processes in order to support green skills development in industry. This study was done in preparation for a major study in Swedish industry. If this matching process is doable, this could improve the upskilling program and contribute to its success. The findings of this study will be used to create a matching system for this platform. By implementing it in that project, it will be possible to gain empirical data.

6. Conclusion

This study argues that there are several approaches to close the skill gap in industry through matching. The initiatives reviewed address different parts that are matched. According to the list of attempts, the parts that play a role in closing the skill gap are skills, employees, job profiles, trends, training items, machines, and tasks. Theoretically, building a system that matches between these parts, could help a learner to find their learning journey and this could bridge the existing skill gap in industry.

The learners themselves play an important role in these investigations, but the review indicates that also the environment of the learner needs to be included in the matching process. The environment consists of employers, human resources, educators, institutions, and policy makers. At this point, there is no reason to believe that this would differ when developing green skills.

To build a matching system in the future, this paper concludes that existing databases listing job profiles, tasks and skills can be implemented in order to identify skill gaps. Further, it is concluded that efficient matching processes require consideration of multiple peripheral domains, such as management, human resources, pedagogy, data analytics, and machine learning.

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