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'Green Skills' for a 'Green and Just Agenda' of Sustainability Transformations

Martina Fuchs, University of Cologne

Summary

Green Skills enable workers for sustainability transformations. Green Skills are related to a bundle of ecological goals and measures. They shall contribute to achieve climate goals, decrease emissions, save natural resources, protect biodiversity and revitalize ecosystems. Frequently, Green Skills have to be aligned with 'just transformations', particularly aiming at the reduction of social inequality and poverty and at the improvement of living and working conditions, including participation, co-determination and empowerment. Green Skills are relevant for production and service creation and they shall be introduced in various curricula and teaching-learning practices of vocational schools and universities of applied sciences, as well as in various kinds of further training. Until now, there is a lack of systematic analysis of how implementation of such vocational and training measures actually takes place. The paper aims to investigate the place-specific contextual preconditions including enabling and constraining factors, by using the example of Green Skills' implementation in German regions. It seizes on desktop research and preliminary insights from pilot studies of ongoing investigation in selected industrialized metropolitan regions.

Introduction

Policies promote Green Skills to enable workers for sustainability transformations. Green Skills are related to a bundle of ecological goals and measures. They shall contribute to achieve climate goals, decrease emissions, save natural resources, protect biodiversity and revitalize ecosystems. Frequently, Green Skills have to be aligned with 'just transformations', particularly aiming at reduction of social inequality and poverty and at improvement of living and working conditions, including participation, co-determination and empowerment (Eadson/van Veelen 2023; Fastenrath/Braun 2018a; UNESCO 2023). According to the sustainability goals of the United Nations (UN 2023), Green Skills make cities ecologically and socially sustainable (UN Sustainability Goal 11) and at the same time contribute to improve education and training (UN Sustainability Goal 4). Socio-ecological sustainability transitions therefore require not only technical and organizational competencies relevant for eco-innovation, but also social competencies, such as the ability to work in teams (Fastenrath/Braun 2018b), to act in a fair and solidaric manner (Grenzdörffer 2021), and personality-related competencies, such as responsibility for carrying out the work task in ecologically and socially sustainable ways (Pavlova 2018; Pavlova/Singh 2022). While there is a broad strand of literature on the objectives of Green Skills policies (Auktor 2020), there is a lack of systematic investigation of how implementation takes place locally. 'The local' here relates to vocational education organizations and companies, and to the regional actor networks that frequently are considered to be on the way to 'Green Skills Ecosystems' (Anderson/Warhurst 2012; Buchanan et al. 2017; Marsden 2015; Röhrer et al. 2021).

The paper addresses this research gap and investigates place-specific preconditions including promoting factors and frictions when Green Skills are implemented in Germany, with a particular focus on selected industrialized metropolitan regions. Due to the lack of systematic and empirically proven studies on this topic, the argumentation is based on desktop-research on the topic of Green Skills. In addition, initial insights are based on pilot studies of ongoing research[1]. The selected documents were interpreted with regard to their content, intentions and interests (Soeffner 2004).

The following starts with conceptual considerations. Thereby, due to the focus on 'the local' in its multi-scalar dynamics, there is a particular focus on contributions of economic geography and labour geography. The paper then presents findings of empirically-based literature and document analysis, thereby integrating contributions on vocational education, and integrates them in a framework designed to analyze the place-specific enabling and constraining factors relevant for the implementation of Green Skills. Finally, the paper highlights perspectives for further research.

Green Skills – Opaque in the 'Green and Just Agenda' of Sustainability Transformations

Green Skills are considered a central part of social-ecological transformations. They are intended to train, sensitize and motivate workers through vocational education and training, practical courses of study and job-related further training to contribute to sustainable processes in production and service creation. Green Skills are important not only in sectors of the economy that are viewed as 'green', but in all sectors, companies, professions and activities (Auktor 2020; ILO 2019). However, the understanding of Green Skills still is opaque, both with regard to ecology and socially just transformation (Affolderbach 2022; Heffron/McCauley 2018; Wheelahan et al. 2022). The implementation of Green Skills policies differs considerably between countries, between federal states and between municipalities, and between these different scales (BMWK 2023; CEDEFOP 2019; CEDEFOP 2022). Until now, it is unclear how general political ideas are implemented in 'multi-scalar' way to the local actor settings. Fastenrath/Braun (2018a, p. 7) emphasize the relevance of such geographically sensitive view, especially for analysis in economic geography on urban development:

> "Without neglecting the exogenous influences on urban transitions, it is crucial to analyse the endogenous characteristics such as local policies (regulation, incentives, and guidelines), local learning processes, and actors (driving and hindering/disrupting)."

With regard to Green Skills, depending on the skill formation system of the particular country and the specific local conditions, various actors are involved in the implementation of curricula and the specific teaching-learning activities. These actors are, for example and depending on the particular regulatory institutional settings, persons and organizational units responsible for vocational education in governmental authorities and public administration; vocational schools, universities of applied sciences and other training institutions; chambers and employers' associations. In *dually* coordinated skill formation systems, companies are also involved in this actor network. These skill formation systems usually are characterized by 'social partnership'; in addition to the employers' side, also employees' representatives are involved, such as trade unions, works councils and trainee representations. This kind of dual skill formation, which exists in German-speaking regions, such as Germany, Austria and parts of Switzerland (Busemeyer/Trampusch 2012), are discussed below.

[1] In particular, we started a project on Green Skills using the example of building technology in the German city of Cologne. The project began in 2024 and is funded by the RheinEnergieStiftung (W-23-2-001). The co-applicants and senior researchers are Prof. Dr. Claudia Ziller (Technical University of Cologne) and Prof. Dr. Matthias Pilz (University of Cologne). The conference paper uses insights of a book chapter that is published in German language (Fuchs 2024).

Generally, international studies only provide eclectic insights on the implementation of Green Skills and hardly differentiate the particular actor settings and institutional frameworks. A considerable strand suggests the relevance of technical-organizational competencies when they relate to Green Skills. For the United States, Consoli et al. (2016) and Shutters et al. (2016) find that technical-organizational Green Skills are more likely to be found in regions where knowledge-intensive companies are located. For European regions, Bachtrögler-Unger et al. (2023) and Santoalha et al. (2021) come to similar results. In general, an understanding of Green Skills is widespread in this strand of research, which, in the sense of human capital theory, sees knowledge incrementally as a competitive factor in the race to the green economy and frequently shows an understanding of skills lacking the different technical-organizational, social and intra-personal dimensions of competencies (Wheelahan et al. 2022).

In contrast to these studies that follow perspectives of economic geography and related fields, studies in vocational education open up the view of Green Skills as competencies that are understood comprehensively (Brockmann et al. 2008; Cabral/Dhar 2020, 66). These comprehensive Green Skills include technical and organizational capabilities, which are designed to be transferable to other tasks ('generic' competencies). In this sense, Green Skills include the handling of work equipment and work objects and include cognitive-analytical knowledge, subjective-associative thinking and haptic-sensory experiential knowledge (Ritter 2017; Sauer 2017).

At the same time, Green Skills in this comprehensive sense also include social skills, such as the ability to act in a sustainability-oriented manner, be it as an executive in a team or in a managerial position. Green Skills also include personality-related skills such as motivation, planning ability and individual responsibility for sustainable work (Ritter/Sauer 2017; Schulz/Trappmann 2023; Theis/Pilz 2014). Green skills require a sense for future developments and for the broad range of possible transformations (Munz 2017; Thunqvist et al. 2023; Weber/Pfeiffer 2023). Green Skills include competencies that enable the learners to contribute to social justice, decent work, solidarity, participation, co-determination and empowerment (Grenzdörffer 2021).

With regard to 'just transformation', there is another relevant issue, in addition to the question of whether social and personality-related skills are being taught. It is relevant to include the question of who actually benefits from the implementation of Green Skills. In general, vocational education and training measures for Green Skills are mainly found at higher and intermediate competence levels (Ritter 2017). Lobsiger/Rutzer (2021) go into more detail about the gender-related consequences and point out that Green Skills primarily affect tasks that young, highly qualified men perform, which would exclude female employees in particular from relevant processes of economic structural change. The ILO (2019) similarly states that Green Skills reach women to a lesser extent, but that at the same time affect older men with low and medium education in 'brown' industries who become losers of sustainability transformations. These notions are in line with a study of Trappmann (2023) on the UK. This study shows that in companies producing raw materials, and in the regions surrounding them, there is a lack of managerial strategies and governmental policies that consider the interests of the blue-collar workers affected by the transformation. These finding is in line with the study of Zbyszewska (2021) who shows the difficulties of trade unions to engage in sustainability matters in the UK. However, industrial relations and their impacts on sustainability transformations differ internationally, as they are embedded in different labour laws and regulation of labour co-determination (Nasikkol et al. 2023). Beyond this perspective on established industrialized countries, there are some studies conducted in emerging economies and countries of the Global South that particularly stress the importance to include the informal economy. Without including the informal economy with its various sectors and the large part of persons with low formal qualifications and related degrees, Green Skills will only be implemented very partially, and will exclude those who

frequently predominantly suffer under environmental pollution, the impacts of climate change and land degradation (Owusu-Agyeman/Aryeh-Adjei 2023; Pavlova/Singh 2022; Rosenberg et al. 2020). There is a general risk that Green Skills mean upskilling for some employees, while others are disadvantaged, whether due to the destruction of jobs or otherwise due to the lack of imparting Green Skills relevant for their future (Kwauk/Casey 2022). Worth mentioning, one may not consider that employees, or trade unions, as party generally refusing sustainability transformations and related trainings. On contrary, as Schulz/Trappmann (2023) show for Germany, workers frequently consider sustainability issues and corresponding skill formation measures in companies as highly relevant. However, workers complain about deficits on the part of managers who frequently ignore the implementation of such training activities.

Case of a *Dual* Skill Formation System

The implementation of Green Skills has been tested in various pilot studies in German-speaking regions, such as Germany, Austria and parts of Switzerland (Albertz/Pilz 2024; Melzig et al. 2021; Meyer 2023; Michaelis/Berding 2022; ProNaK 2017; Weber/Pfeiffer 2023). These studies show consistently that in these kinds of skill formation systems with their complex institutional frameworks and that involve various actors on multi-scalar levels, the implementation of Green Skills in teaching-learning processes has apparently not been carried out systematically so far (Melzig et al. 2021; Michaelis/Berding 2022). Particularly for the skill formation system in Germany, studies show that imparting Green Skills depends severely on the individual motivation of the teachers and trainers and is not yet well established in overarching teaching-learning practices (Weber/Pfeiffer 2023). There is a lack of appropriately trained staff who could act as multipliers. In Germany, until now Green Skills are not a required part of final examinations of vocational education and training. Therefore, from the teachers' perspective there is no real need to teach them in class. Priorities often lie in teaching language and linguistic skills, and basic mathematical operations (Albertz/Pilz 2024).

A study published by various non-governmental organizations in Germany on financing education for sustainable development in schools stresses the lack of financial resources (Teichert et al. 2018). Trade unions criticize that there are often only short training courses for Green Skills, which lack to impart social and personality-related competencies (Hannack 2023). Moreover, teachers complain about didactically prepared teaching materials about sustainability transformations that relate to the particular profession. Green Skills differ, for instance, considerably for retail merchants, industrial mechanics and employees employed in hospitality business (Albertz/Pilz 2024; Fuchs et al. 2021; von Jorck et al. 2023; Müller et al. 2023).

These findings explain that in the regions that politicians want to become “Green Skills Ecosystems” (Anderson/Warhurst 2012; Buchanan et al. 2017; Marsden 2015; Röhrer et al. 2021), the topic of Green Skills often is by far not on the top of the agenda (Klinger et al. 2021; Trappmann 2023). At the same time, there are institutionalized rules and guidelines in German regulation on vocational education and training for the intermediate skill level (Müller et al. 2023). Moreover, specifications exist for teaching Green Skills in practice-oriented study programs of universities of applied sciences, and in further education (BMWK 2023; BNE 2023; ProNaK 2017). While pilot studies illustrate considerable potential for imparting Green Skills (Ritter 2017; Ritter/Sauer 2017; Melzig et al. 2021; Weber/Pfeiffer 2023), the majority of the findings indicate that there is a gap between ambitious objectives and teaching-learning practices (Bosch/Schmitz-Kießler 2020; Vogelsang/Pilz 2022).

In addition to these frictions that exist at the learning locations and at the work place at micro-level, the local preconditions also have to be considered. While research largely neglects this local view, the different local economic preconditions (particular economic sectors and the particular companies) have to be considered. In addition, the view on the local conditions has to include further

ecological conditions that are perceived as relevant by local actors. Moreover, political strategies and measures relating to these settings have to be considered. The following examples from Germany focus on selected metropolitan regions characterised by different industries, perceived ecological challenges and political strategies and measures.

In *Cologne,* Green Skills policies are part of a local development policy that focusses on climate-resilient urban development. As Cologne is bordered by a hilly landscape and situated in a mild climate, which makes the city vulnerable to warming processes and heavy rain. At the same time, there is the river Rhine, which offers opportunities for using the water for sustainable energy and new techniques that lower summer overheating and allow efficient cooling at night. Therefore, *building technology* is a relevant starting point for local sustainability transformations. Moreover, in this sector Green Skills include competencies for the development, construction, conversion, renovation and operation of green buildings (Clasing et al. 2022). Studies on the building sector have shown that such sustainability transformation of cities require not only technical skills on building materials, building processes etc., but also comprehensive social Green Skills, especially the ability to work together in a team and thereby connect different professions and crafts who often derive their self-understanding from their longstanding experience and work routines, and who have developed their own standards and technical norms for their work processes (Fastenrath/Braun 2018b).

If we compare this case to other regions in Germany, the relevance of the peculiarities of the particular industrial sector becomes relevant. Large companies sometimes play a role as lighthouse projects. Moreover, cases show that the 'just transformation' goes beyond the kind of social Green Skills mentioned above; vocational education and training related to disadvantaged groups on the labour market also play a role. The question of whether social and personality-related skills are being taught is relevant, as well as the question of who actually benefits from the implementation of Green Skills.

For example, the *Ruhr area* is an industrialized region with a focus on *steel industry* undergoing structural change. In addition, *chemical industries* are important. There are various activities to promote Green Skills in these sectors that frequently are characterized as in 'brown' industries. Since decades, companies and other the regional actors (vocational training institutions, trade unions, associations, chambers) fight for, argue about and negotiate the course of structural change. They already have established local initiatives in vocational education and in further education, because the decline of coal industries and the restructuring of steel companies have generated a high unemployment in the region since the 1980s. Building on this established actor network, and by creating new constellations of actors, new initiatives for Green Skills have emerged (LANUV 2023; Revierwende 2023, Metropole Ruhr 2023). They exist in large cities of the Ruhr area, such as in the 'steel city' Duisburg (Nasikkol et al. 2023), and in medium-sized cities, such as in Bottrop and Recklinghausen (Stuart-Hill/Markus 2022). In the Ruhr area various programs and agencies for Green Skills emerged that try to give persons with low formal qualifications better access to 'green' jobs in newly emerging industries and branches (RAND 2022). A particular focus is on eco-innovation in steel industries. Here, particularly hydrogen plays an important role to replace no non-renewable heating materials. In this respect, the Ruhr area represents a region in structural change with severe labour market problems, where several initiatives and measures promote Green Skills in the direction of 'just transformation', especially for those with low formal qualification.

The *automobile industry* is changing to electromobility. Among other automobile regions in Germany, this affects the industrial triangle of Stuttgart, Karlsruhe and Mannheim, where large brand-name manufactures and several medium-sized, technology-intensive firms are located (so called hidden champions). This region is characterized by actor networks that have been established since the 1980s, when automobile industries experienced severe crisis. Building on such experiences

of regional cooperation, Green Skills have become part of local strategies connecting different actors, also those with different interests. For example, the two collective bargaining parties IG Metall Baden-Württemberg and Südwestmetall created a joint institution to early evade Green Skill gaps (AgenturQ 2023). In addition, there are specialized organizations that focus on teaching skills for sustainability transformations, such as the “Forum Global at the Vocational Seminar in Karlsruhe” (BNE 2023). This region represents a dynamic case with a mix of large companies and medium-sized companies with hidden champions as well as a supportive social partnership-based policy that explicitly focuses on vocational training-related Green Skills.

Figure 1 summarizes the findings of desk-top research and case studies and illustrates the place-specific contextual preconditions including enabling and constraining factors of the implementation of Green Skills in Germany. The figure thereby shows that the local skill formation system, the local actor setting with its institutional particularities, is embedded in a multi-scalar setting; at the same time, it has impacts on the teaching-learning processes in vocational education organizations and further training organizations.

Figure 1: Place-specific preconditions of the implementation of Green Skills in Germany (own figure)

Conclusion and Perspectives

The findings indicate that, in principle, technical-organizational Green Skills combined with social skills are on the international political agenda. However, ideas about implementation are diverse and the requirements and interests regarding climate change, use of natural resources, emissions and biodiversity vary between the actors on different spatial levels, and Green Skills are not necessarily on the top of the agenda of local actors. A research desideratum is that in empirical research the understanding of Green Skills must be reconstructed according to the ideas of those involved and critically compared with the understanding as it exists in policy papers (e.g. CEDEFOP 2019; ILO 2015). This requires to analyze the notions and substantial interests of the local actors who claim that they contribute to sustainability transformations (Braun et al. 2018; Feola et al. 2023; Pitidis et al. 2023; Schulz/Braun 2021). A key task is to discover hidden conflicts of interest about the direction of change, and strategic action conflicts, particularly related to diverging ecological and social sustainability dimensions (Haunschild et al. 2021; Klagge/Meister 2018; Schulz/Trappmann 2023; Zademach/Hillebrand 2014). Such a reconstructive approach avoids a distortion of empirical reality through a predetermined construct of 'greenness'. The critical view is necessary due to the various

narratives, policies and institutional reforms surrounding Green Skills, which bear the risk that Green Skills become a catchphrase and the term is misused for greenwashing strategies (Blythe et al. 2018; Schumacher 2022).

Green Skills, as well as sustainability transformations in general, are a highly normative topic (Braun et al. 2018; Schulz/Braun 2021). This makes it necessary to analyze the imaginaries and related interests of the local actors who claim that they contribute to 'Green' place-making (Feola et al. 2023; Pitidis et al. 2023). The operationalization of 'Green' according to the respective environmental legislation is a starting point (Vona et al. 2018), as well as further specifications and rules, such as guidelines and standards (ISO 2022; Thannisch et al. 2023).

Another research perspective is to examine the tangible *impacts* of Green Skills on sustainability transformations. A key question is if Green Skills really change the various routine processes in companies (Ritter/Sauer 2017), and, moreover, support innovation in companies (Auktor 2020; BMWK 2023; CEDEFOP 2022; Ritter 2017). Until now, research has neglected to analyse if Green Skills really do have an impact on the generation of eco-innovations (see OECD 2018). This analysis, in fact, is challenging, because even the overarching question of whether employees' competencies in general (and not just Green Skills) promote innovation in companies is answered differently in international literature (Wheelahan et al. 2022). However, studies on *dual* vocational training systems suggest that there is a positive effect of training on innovation activities (Rupietta/Backes-Gellner 2019), including medium-sized companies (Matthies et al. 2023).

Related to the question on the impact of Green Skills on innovation is how they contribute to regional structural change (Boschma et al. 2017; Dewald/Fromhold-Eisebith 2015; Thunqvist et al. 2023). It is still open how Green Skills promote 'path plasticity' (Strambach 2017; Strambach/Pflitsch 2018) or even foster 'new path creation' in the region (Eadson/van Veelen 2023; Hassink et al. 2019), and how this possibly has impacts even on supra-regional levels. In particular, these impacts can be analysed by using the multi-level approach of the 'Transition Studies' (Geels 2012). As this approach highlights, regional structural change is not only related to innovation in companies. Moreover, regional structural change, and related sustainability transitions, include new topics and processes in regional policies, planning and practices. Such new patterns of cooperation between regional actors can be examined by using the 'transition topology', suggested by Strambach/Pflitsch (2020). With regard to Green Skills, this allows to reconstruct the gradually changing regional actor constellation towards sustainability and, possibly, towards Green Skills Ecosystems (Anderson/Warhurst 2012; Buchanan et al. 2017; Marsden 2015; Röhrer et al. 2021). The impact of Green Skills on local eco-innovation and regional structural change therefore still requires further research (Østergaard et al. 2019; Ritter 2017).

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