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Green skills at Industrial Training Institutes in India: An exploratory study of VET teachers' subjective theories

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ABSTRACT

This study addresses the subjective theories of vocational education and training (VET) teachers on green skills, as their understanding and attitude towards phenomena can influence teaching, students and institutions on a large scale. Specifically, the study focuses on Indian teachers at Industrial Training Institutes (ITIs), as these institutions are the main providers of formal vocational training in India. Despite the increasing demand in India for a workforce equipped with green skills, research on this subject, particularly from the perspective of VET teachers, remains limited. To address this gap, semi-structured interviews were conducted with 54 teachers across 19 ITIs in New Delhi and Bangalore. The findings reveal a diverse spectrum of teachers' subjective theories on green skills, ranging from a lack of understanding, through a simple and pragmatic approach with environmentally friendly activities, to a technical approach, and finally to a broader view involving green moral values. Teachers' attitudes towards green skills in vocational training are more favourable when they perceive a direct link between green skills and technical skills in their trade. The study is of both scientific and practical relevance, as investigating teachers' subjective theories is crucial for further development in teacher training, continuing education and VET curricula in India and beyond.

1. Introduction

India, as a rapidly developing nation, is increasingly confronted with complex social and environmental challenges arising from the climate crisis. In absolute terms, India ranks among the world's highest CO_2 emitters, following China and the United States, thus playing a significant role in global emissions. At the same time, India's per capita emissions and energy consumption remain comparatively low (Ritchie and Roser, 2020). In recent years, the country has notably expanded its renewable energy capacity, particularly in the solar sector, as part of its national strategy to achieve net-zero carbon emissions by 2070 (Mukherjee, 2025). Despite these efforts, it remains uncertain whether India will be able to stabilise or reduce its overall emissions in the near future, even with the rapid growth of renewable energy. What is clear, however, is that the government's commitment to green growth has implications for the labour market and skill development. While sectors such as renewable energy and energy efficiency are generating new green jobs, traditional emission-intensive industries including coal, steel and cement are experiencing employment losses. Additionally, the green restructuring of various industrial sectors necessitates the retraining and upskilling of workers. Thus, demand for green-skilled and environmentally conscious labour increases, particularly at low and medium skill levels (ILO, 2023; Ham et al., 2024).

In response to this, the Indian government established the Skill Council for Green Jobs (SCGJ), which focuses on the identification of green skills needs, the development of skill standards and the delivery of training programmes in green sectors such as transport, renewable energy, waste and water management and construction (Bishnoi and Rai, 2022; Pavlova, 2022). Further institutions, like the Pandit Sunderlal Sharma Central Institute of Vocational Education (PSSCIVE, 2021), are also engaged in green skills development. While both macro-level policy interventions and targeted training programmes, also referred to as "parcels" of green skills, represent important progress, they must be viewed in relation to the formal vocational education and training (VET) system, with its underlying training and pedagogical approaches (Stroud et al., 2024, p. 3). In the Indian VET system, there is a paucity of structured greening strategies (Mathur et al., 2022; Bhandari and Sharma, 2024). As Pavlova (2012, p. 12) observes, key VET institutions such as Indian Industrial Training Institutes (ITIs), Polytechnic Colleges and National Institutes of Technology exhibit "no visible approaches

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towards greening".

Within the framework of the 'greening VET' agenda (UNESCO, 2013), teachers are considered to be key multipliers and driving forces in the realisation of green skills (UNESCO-UNEVOC and CEDEFOP, 2024). Teachers' individual understanding of green skills influences their actions, such as the way they design and implement teaching in the classroom, and consequently students' learning processes (Diep and Hartmann, 2016; Pavlova and Chen, 2019).

In this context, Groeben (1990) and Grotjahn (1991) refer to the concept of subjective theories as those theories have an impact on how teachers interpret and carry out teaching and learning. Subjective theories are often implicit, close to everyday life, relatively stable and an important factor in shaping actions. In contrast, objective theories are scientifically founded explanations of phenomena that have general validity independent of individual understandings. Subjective theories resemble scientific theories insofar as they provide explanations for observed reality. Nevertheless, they differ in that subjective theories are not systematically evaluated but rather constructed on a subjective basis. The development of subjective theories is influenced by personal experience, the social environment, professional practice and training (Koch et al., 2013).

The investigation and identification of subjective theories in the fields of education, learning and teaching has proved beneficial (Dann, 1992). Therefore, international educational studies have analysed teachers' subjective theories on phenomena like sustainable development (SD), since teachers' subjective theories do not necessarily correspond to objective theories and teachers may have a different understanding. For example, Lohmann and Goller (2022), as well as Goller and Markert (2025), focused on teacher educators' subjective theories on education for sustainable development (ESD), and discovered that a wide range of subjective theories on SD and ESD exists. In the field of international VET research, there is presently a paucity of studies that address the subjective theories of VET teachers in general and also in the domain of green skills.

In the context of India, little is known about how VET teachers perceive green skills. So far, only one minor quantitative study has investigated the status quo of teaching and learning of green skills, following the perspectives of VET students rather than those of VET teachers (Mahapatra and Ravichandran, 2023). In view of this research gap and the increasing urgency of green skills development in the Indian labour market, it is particularly relevant to examine the subjective theories of Indian VET teachers on green skills.

This exploratory study addresses this issue and provides evidence of how Indian VET teachers understand green skills and what attitudes they hold towards green skills in vocational training. Whereas understanding involves individuals grasping the meanings of phenomena, attitudes are understood as reactions to phenomena, which can be positive or negative in the form of individual opinions, values and beliefs (Ajzen and Fishbein, 2005). In this study, subjective theories function as an analytical framework for the reconstruction of individual perspectives. In order to analyse the status quo of teachers' subjective theories, national and regional characteristics and teachers' individual socio-cultural and professional backgrounds are taken into account (Wals, 2009; Blum et al., 2013).

For this purpose, qualitative interviews were conducted with teachers from ITIs in New Delhi and Bangalore, given the relevant role these institutions play in the Indian VET system (Venkatram, 2012; Kumar, 2016). ITIs, as the oldest and largest vocational training institutions in India, contribute substantially to the formal qualification of young individuals for the world of work (Agrawal and Agrawal, 2017; Schneider and Pilz, 2024). Operating under the Craftsmen Training Scheme (Wessels and Pilz, 2018), approximately 15,000 governmental and private ITIs accommodate around 2,7 million trainees (MSDE, 2021). ITIs offer a diverse range of technical and non-technical training programmes, which vary in duration from six months to two years and are accessible after completion of the eighth, tenth, or twelfth grade, depending on the specific trade (Pilz and Regel, 2021). To qualify as a teacher at an ITI, candidates must complete a one-year training programme under the Craft Instructor Training Scheme (CITS). However, a significant proportion of ITI teachers hold only an ITI certificate and lack formal pedagogical qualifications and relevant professional experience in the industry (Pilz and Gengaiah, 2019; Pilz and Regel, 2021). Professional development opportunities remain sporadic and insufficient (Ajithkumar, 2016). Additional challenges faced by ITIs include poor infrastructure and equipment, outdated curricula, financial constraints and limited collaboration with industry (Tara et al., 2016). As a result, graduates are often neither immediately employable in the industrial sector nor sufficiently qualified to start their own business (Schneider and Pilz, 2024). The social acceptance and reputation of ITIs remains low, which is reflected in the fact that less than half of the available training places are filled (NITI Aayog, 2023).

The following section provides a general overview of the objective theories on green skills from the perspectives of supranational organisations and research. Additionally, the current state of research on green skills in Indian VET is presented, and the research focus of this study is further explained. The third section outlines the applied research methodology. Thereafter, the results examining teachers' subjective theories on green skills are outlined and discussed against the backdrop of objective theories on green skills. Finally, an outlook on green skills in the Indian and international context is given.

2. Definitions, state of research and research focus

At the global level, within the context of the Agenda 2030 for Sustainable Development determined by the United Nations (2015), the 'greening VET' agenda serves as a strategic approach for embedding sustainability in VET. Its primary objective is to equip individuals with green skills and foster environmental consciousness among them (UNESCO, 2012, 2022). UNESCO-UNEVOC (2017), as a central driver of the agenda, conceptualises the greening of VET as a holistic institutional approach aimed at fostering the development of green knowledge, skills and attitudes conducive to sustainable practices, green economies and climate-resilient societies through formal, non-formal and informal learning environments (UNESCO, 2013).

Building on this, green skills emerge as a fundamental component essential for the promotion of green practices and facilitating the transition towards a green economy across all sectors and levels (OECD and CEDEFOP, 2014). In the literature, no universally accepted definition of green skills exists. The ILO (2015, p. 34) clarifies that "there is little consistency in the meanings assigned to [green skills]. Sometimes it is used to refer to core skills such as environmental awareness, sometimes to technical skills relating directly to the environment, sometimes to skills in green technologies, sometimes to skills for green sectors or green processes". According to CEDEFOP (2012, p. 20) green skills encompass "knowledge, abilities, values and attitudes needed to live, work and act in economies and societies seeking to reduce the impact of human activity on the environment". This conceptualisation introduces a three-tiered distinction: transversal skills that foster environmental awareness and sustainable thinking and acting; specific green skills related to implementing environmental standards and protective measures; highly specialised green skills associated with advanced green technologies (ETF, 2021; CEDEFOP, 2024). The European Commission (2022) has developed a taxonomy of skills for the green transition including 381 skills, 185 knowledge concepts and five transversal skills which are relevant for a greener labour market.

Pavlova (2022, p. 7), a VET researcher with a focus on Asian countries, defines green skills as those "needed to reduce environmental impacts and support economic restructuring with the purpose of attaining cleaner, more climate resilient and efficient economies that preserve environmental sustainability". Pavlova (2018), (2022) differentiates between generic green skills needed for all occupations including technical skills, and specific green skills required for certain

professions. Pavlova (2018), (2022) also emphasises the critical role of environmental awareness, attitudes and values (often termed as 'green mindsets') as foundational elements of green skills. Given this broad conceptual scope, Cabral and Dhar (2020) propose the notion of green competencies, encompassing green knowledge, skills, abilities, attitudes, behaviours and awareness related to sustainability. In their literature reviews, Fuchs (2024) and Montanari et al. (2023) analyse the meanings of green skills in various strands of literature further.

The concept of green skills is also the subject of criticism in the research literature, as discussed by McGrath and Powell (2016) and Ramsarup et al. (2024), who label green skills as a floating signifier. Green skills should extend beyond technical skills and also encompass social justice, environmental awareness and critical engagement, as current approaches often prioritise economic and technological goals at the expense of quality of life and equity.

In the context of India, green skills are seen as part of broader training and skills development policies, rather than being treated as an additional, distinct topic, separated from other forms of skills. Green skills are not only associated with executing tasks in green jobs but are also considered fundamental for daily activities that contribute to environmental protection and sustainability (Bishnoi and Rai, 2022; Pavlova, 2022). Accordingly, green skills are essential not only in the renewable energy sector (Varghese et al., 2018), but also in other domains such as waste and water management, which remain underrated in Indian society (Chandrasekar et al., 2023). Apart from this, the ILO (2023) criticises the lack of definitions and assessment guidelines for green skills in India to serve as a basis for skill and employment policies.

The majority of the Indian workforce has not formally acquired green skills (Varghese et al., 2018; Bishnoi and Rai, 2022), except through self-directed learning or corporate training programmes (Unnikrishnan and Hegde, 2007). Mathur (2022) highlights that existing vocational training programmes primarily focus on technical skills, with limited attention given to green skills. This trend is attributed to uncertainty among public training providers regarding the integration of green skills into training programmes and the absence of regulatory frameworks and certification mechanisms (Maclean et al., 2018). Mahapatra and Ravichandran (2023) demonstrate that, despite Indian students encountering green skills within vocational education institutes, predominantly at a theoretical level, and expressing favourable attitudes towards them, they lack a consistent or comprehensive understanding. The green skills addressed in their study (e.g., switching off lights and unplugging electronic appliances when not in use, planting trees) are mainly based on the aforementioned daily green practices for environmental protection. The lack of trained VET teachers in the green sector and inadequate teacher preparation for green skills training present additional challenges in India (Reddy, 2016; Maclean et al., 2018; Bhandari and Sharma, 2024).

In summary, the literature demonstrates that objective theories understand green skills as both technical and specific technical green skills, such as those related to new green technologies, as well as soft or generic green skills. On top of that, green moral values are incorporated. Apart from these definitions provided by supranational organisations and research, Langthaler et al. (2021) emphasise that the understanding of green skills is not static and varies according to national context, jurisdiction and organisation.

Given the absence of empirical data concerning the individual understanding of green skills among Indian VET teachers and the subjective theories they hold, this study addresses this desideratum. The research interest is of pertinence given that teachers' subjective theories on green skills can differ from those of objective theories. Teachers' perceptions have a substantial influence on the practical implementation of educational content in the classroom, frequently deviating from the objectives delineated in official documents such as curricula (Edwards et al., 2009). By researching VET teachers' subjective theories, valuable insights can be gained into existing patterns of interpretation and can thus create an empirically sound basis for further teacher training and curriculum development in Indian VET and beyond.

3. Research methodology

Qualitative methods are particularly well-suited to the investigation of subjective theories and personal patterns of interpretation of phenomena. As subjective theories are closely linked to professional experiences and institutional contexts, they are difficult to capture using standardised surveys and instead require dialogue settings. Therefore, for instance, Lohmann and Goller (2022) and Goller and Markert (2024) employed semi-structured interviews as a starting point for their studies, subsequently adopting the structure-formation technique as outlined by Groeben and Scheele (2000). This approach enabled not only the examination of the individual participants' understanding but also facilitated a subsequent reflection on this understanding.

As this study was designed to be exploratory and to provide initial access to the subjective theories of Indian VET teachers on green skills, it was decided to conduct exclusively guideline-based, semi-structured interviews with VET teachers Schmidt, 2004). The objective of this study was to outline initial orientations and interpretation patterns without resolving these in the sense of a deeper structuring or validation.

The study focused on two distinct locations, one in the North (New Delhi) and one in the South (Bangalore) of India to capture a nuanced view of teachers' subjective theories, considering the diverse contextual conditions present across regions. The study was carried out predominantly in urban settings with comparatively well-developed infrastructure. However, in the Bangalore region, five ITIs situated in more rural areas approximately 100 kilometres outside the city were also included. Although both New Delhi and Bangalore represent major urban centres in India, there are major differences in terms of language (Hindi, Kannada), regional identity, the ethnic composition of the population and the form of the local economy, which may also be reflected in the subjective theories of teachers.

During the preparatory phase of the field research, individual interviews with ITI teachers were initially planned. However, as data collection progressed, it became apparent that group interviews were more appropriate for this target group. ITI teachers exhibited a greater willingness to participate in group settings, which also facilitated mutual support in overcoming language barriers. Group interviews are particularly well-suited for exploratory research, as they promote the articulation of diverse interests and values and illuminate potential contradictions and ambiguities (Frey and Fontana, 1991).

A total of 54 teachers from governmental and private ITIs were interviewed (see Table 1). Participation was voluntary and access to ITIs was enabled through collaborations with local partners and a snowball sampling approach involving ITI principals. Interviews were conducted on the premises of the respective ITIs, with participating teachers predominantly pre-selected by the principal. It is important to note that, since the interviews were conducted in English and the participating teachers were selected by the management based on their English proficiency, there is a possibility of data bias. Teachers less proficient in English may have been less likely to take part in the interviews. In addition, the fact that the research team consisted of two European researchers may have influenced the data generation and interpretation, potentially introducing a cultural or positional bias.

The interview guideline was developed based on previous qualitative research investigating teachers' perceptions and interpretations of green skills and sustainability asking questions such as "What do you understand by green skills?" and "To what extent are green skills important in vocational training from your perspective?" (e.g., Nguyen, 2018; Li et al., 2023). To reveal underlying interpretative patterns, teachers were further encouraged to provide concrete examples of green skills within their specific trades. This was also intended to counteract the issue of social desirability, a prevalent phenomenon in the context of India (Regel et al., 2022). As is usual for exploratory group interviews, the guideline consisted mainly of open-ended, flexible questions, which

Table 1
Overview of the interviews sample.

Bangalore			
Type of ITI	**Trades/Subjects**	**Participants**	**Duration**
Governmental ITI_B1	Electronics Mechanic Employability Skills Fitter Mechanic Electric Vehicle Turner	7	44 Min.
Governmental ITI_B2	Electronics Mechanic Fitter	4	38 Min.
Governmental ITI_B3	Electronics Mechanic Fitter	2	26 Min.
Governmental ITI_B4	Electrician Fitter Mechanic Electric Vehicle	4	30 Min.
Governmental ITI_B5	Electronics Mechanic	2	22 Min.
Governmental ITI_B6	Employability Skills Fitter Mechanic Electric Vehicle	4	26 Min.
Governmental ITI_B7	Electronics Mechanic	2	23 Min.
Governmental ITI_B8	Electrician Fitter	2	24 Min.
Governmental ITI_B9	Computer Operator and Programming Assistant Information Technology and Electronic System Maintenance Electronic Mechanic	3	25 Min.
Private ITI_B10	Fitter Machinist Turner	3	27 Min.
Private ITI_B11	Mechanic Motor Vehicle	1	21 Min.
New Delhi			
Governmental ITI_D1	Fashion Design Technology	1	30 Min.
Governmental ITI_D2	Computer Hardware and Networking	3	33 Min.
Governmental ITI_D3	Employability Skills Technician Mechatronics Turner	3	40 Min.
Governmental ITI_D4	Computer Operator and Programming Assistant	2	22 Min.
Governmental ITI_D5	Computer Operator and Programming Assistant Employability Skills Mechanic, Machine Tool, Maintenance	3	32 Min.
Governmental ITI_D6	Computer Operator and Programming Assistant Computer Hardware and Networking Employability Skills	3	31 Min.
Governmental ITI_D7	Machinist Plumber Welder	3	40 Min.
Governmental ITI_D8	Electrician Welder	2	58 Min.

allowed participants to articulate their views in ways that were meaningful in their specific socio-cultural and institutional contexts (Frey and Fontana, 1991). The initial part of the guideline was followed by questions about the (potential) implementation of green skills in the classroom (Posner, 2004). Although the latter part extends beyond the primary objective of this study, an analysis of the full interview dataset was deemed necessary.

To ensure confidentiality and data protection, all interviewees were guaranteed anonymity. Interviews were audio-recorded with participants' consent. The recordings were subsequently transcribed in full using 'f4transcript' software.

The qualitative data were analysed using a combination of qualitative content analysis and interpretative approaches to ensure the exploratory nature of the study. The content analysis was conducted in a deductive-inductive manner, initially orientated around the aspects of green skills summarised in section two, which were subsequently supplemented inductively from the data material (Kuckartz, 2014). The interpretative analysis also enabled a more in-depth examination of teachers' subjective theories within their socio-cultural and economic contexts (Soeffner, 2004).

4. Results

The analysis of the interviews reveals a diverse spectrum of teachers' subjective theories on green skills, which are presented below. Accordingly, subjective theories can be categorised into three themes: technical green skills, green skills understood as green activities, and green skills that embody green moral values.

First, it is relevant to mention that some teachers had no understanding of green skills as one faculty member stated explicitly: "I do not know about green skills actually. What is that, green skills?" (ITI_B8). This response highlights a deficiency in imagination concerning the potential scope of green skills. Furthermore, green skills were associated with agriculture, forestry and farming along with digital skills, and were conceptualised in terms of broader socio-economic well-being, equating them with notions such as "peace and prosperity" (ITI_B2), "no mental stress" (ITI_D2) and "health and wealth" (ITI_B9). For most of the teachers with little, or a vague understanding, green skills were perceived as less important for vocational training at ITIs because they do not add value. Green skills are not needed in later employment and in the industry, as one teacher succinctly summarised, "after ITI, students will work in the industries, and they do not need the green skills there. So, it is enough and not so important in our ITI training" (ITI_B9). It can be assumed that teachers who lacked understanding had rather a dismissive attitude towards green skills in vocational training.

4.1. Subjective theories on green skills as technical green skills

The majority of teachers interviewed demonstrated a technical understanding of green skills, associating them with trade-specific technical skills, as one teacher noted: "Maybe green skills are both, soft and hard skills, but I think the focus is on the technical skills" (ITI_B8). Because "the technical skills are the most important in our vocational training" (ITI_D2), many of the teachers perceived green skills as less important, unless they have a concrete connection to technical skills. One respondent maintained that green skills are not important to the trade electronics but might be pertinent to other trades such as cosmetology, suggesting that their integration should be context dependent. This stance could also be interpreted as justification for omitting green skills from technical training.

The importance of those green skills that are explicitly linked to renewable, clean energy and green technologies was recognised, as shown by one response: "Green skills mean that we use the resources which are renewable just like air and wind, sunlight, water" (ITI_D3). Specific green jobs such as solar technician or mechanic electric vehicle were referred to: "Green skills are technical orientated, maybe regarding the green energy, like solar or e-vehicles" (ITI_B10). Some ITIs recently introduced courses in these green professions: "We have started a new course. In the form of solar technician here, in which we teach [the students] how to install panels, in which direction we have to install the panels to get the maximum output from the sunlight. And what are types of solar panels" (ITI_D8). This aligns with the transition to green technologies, which, as noted by teachers, offer environmental benefits through reduced energy consumption.

Electronics teachers highlighted the importance of material selection in relation to green skills, particularly regarding hazardous substances such as lithium, which pose risks if not disposed of properly. Consequently, teachers emphasised the necessity of using long-lasting, natural, environmentally friendly materials, like in "traditional, ancient times" (ITI_D6). A teacher from fashion design technology related green

skills with minimising fabric waste, thereby promoting cost efficiency and sustainability. Recycling was extensively discussed in relation to the utilisation and exploitation of resources: "I think green skills are also about the 3 R concept like reducing, reusing and recycling of materials and resources" (ITI_D1). On top of that, the importance of extending the life cycle of machines and tools through maintenance and repair rather than immediate disposal was mentioned. The "zero waste" concept (ITI_D1) and effective industrial waste management were also stressed, with teachers advocating for proper waste segregation and disposal systems: "[Using] different types of dustbins with all the different types of waste. And through this we can manage it to make our environment and surroundings clean" (ITI_D6). Thus, "green skills are about the management of different waste" (ITI_B1) such as electronic waste, dry waste and chemical waste. Reference was also made to the "5S" concept: "So, green skills are about the 5S concept, sorting, setting, shining and cleaning, standardising, sustaining. So, in this way, the students will learn green skills" (ITI_B1). This Japanese concept is proposed as a methodological approach to enhancing students' efficiency, productivity and safety in the workplace. Following this, associations between green skills, safety and maintenance of order in the learner's workplace became clear. Safety primarily involves the use of personal protective equipment such as goggles, masks and gloves, as one teacher explained: "So, [the students] have to take care of their own safety and also on the safety of the environment. So green skills are really about their own safety, not to harm their body, their eyes, their hands and also not the environment" (ITI_B3).

Overall, most of the teachers with a technical understanding of green skills had a more positive attitude towards them in vocational training, when they saw a link to technical skills of the respective trade. Due to this, as well as the applicability and relevance in the industry, these teachers believed that "green skills are important for the future workforce" (ITI_D5).

4.2. Subjective theories on green skills as green activities

The interviews also revealed a teachers' practical, pragmatic and hands-on understanding of green skills focussing on environmentally friendly activities for environmental protection. Many of these teachers stressed the application and importance of green skills in daily life. One teacher elaborated this perspective as follows: "So, maybe [green skills] are about the environment. Like taking care and maintaining the environment every day" (ITI_D4). Green skills were frequently perceived as "skills for behaving in an ecofriendly way" (ITI_D7), underscoring their importance in both personal and professional contexts. These included simple actions, such as the planting of trees, as one participant noted: "To avoid the pollutions in the city, we should plant more and more trees" (ITI_B9). However, it was argued that tree-planting alone is insufficient, highlighting the importance of ongoing care and sustainable maintenance practices: "And not only planting trees, […], also to take care of that. It is very important, watering and natural fertilisers. It should not be harmful to that environment" (ITI_B3).

Additionally, the reduction of daily resource consumption, such as electricity, water and paper, was identified as a component of green skills: "Green skills for me mean to use energy in a proper way, efficient way so that it may reduce the impact to the environment" (ITI_D8). Teachers also discussed sustainable transportation practices, such as the use of public transport and bicycles, thus reducing reliance on personal vehicles to reduce CO2 emissions. Classroom activities reinforcing sustainability, such as routine cleaning exercises and waste collection, were underlined as integral to inculcating lifelong eco-friendly habits among students. It is evident that many of the teachers understood green skills as environmentally friendly activities and perceived them as important not only for ITIs, but also for other educational institutions such as schools, colleges and universities. Consequently, the majority of these teachers exhibited a more favourable attitude towards green skills in vocational training and beyond, although this was not the case for all.

4.3. Subjective theories on green skills as green moral values

The minority of interviewed teachers shared a moral understanding of green skills. They mentioned the necessity of fostering an environmentally conscious mindset and awareness. The development of green values and green mindsets to become a "moral person" (ITI_D2) was described as an integral component of green skills, with one teacher stating, "these green skills should come from within, from their mind, their heart. […] It is about their willingness. It cannot be forced upon" (ITI_B2). Green skills were thus seen as fostering individual and "public responsibility" (ITI_B10), enabling individuals to make informed decisions and exert positive environmental impact in their lives: "[…] because they will work in the factories, they will have an impact and they can make an impact, if they know how. If they have the right skills, the green skills" (ITI_B11). Green skills were thus framed as fundamental for all citizens, with one participant noting: "We as a human being have destroyed the land so much, our earth, our country so much. And [green skills are] really needed now to save our Earth" (ITI_B7).

In accordance with this, the important role of green skills in fostering sustainable development was recognised: "[The] main objective [of green skills] is the sustainability, to create sustainability" (ITI_B6). These perspectives encompassed long-term environmental and social considerations, including intergenerational equity: "I think green skills are also important for the future development and for future generation, developing a green mind, always taking care of the nature, thinking about your own behaviour and the consequences" (ITI_B4). This nuanced perspective acknowledges the complex interdependencies between ecological, social, economic, and technological dimensions of sustainable development, as one teacher highlighted: "We have to maintain a good industry and environment, both. Sometimes, it is difficult to reach because industry and company have other interests than what is good for the environment […]. So, I think green skills is about finding solutions which are good for industry and for environment, because we need both in our India" (ITI_B1). Teachers also connected green skills to broader social issues, such as the impact of environmental degradation on poverty and public health. Green skills were also aligned with the United Nations' (2015) 17 Sustainable Development Goals, acknowledging their potential contribution to global sustainability objectives.

It is noteworthy that while some teachers with this broad understanding perceived green skills as important for vocational training, others expressed the view that "green skills are more suitable for Polytechnics or Universities than for ITIs" (ITI_B11). This viewpoint was reinforced by concerns that ITIs and their students might not constitute an appropriate target group for green skills: "Here, in the villages, people cannot even read and write their own native language, Kannada language. So, you see, we are facing big challenges with our students at this ITI. I think, the green skills are not so important then because we have other problems. First, students should be able to speak, to read and to write, then we can start teaching them [green skills]" (ITI_B5). Another teacher echoed this sentiment, asserting that "only basic knowledge is enough for these people, maybe the green skills are too much" (ITI_B7). This statement implies that some teachers perceived ITI students as lacking the cognitive capacity to engage with green skills, thereby prioritising other aspects such as career preparation as this is much more important for vocational training at ITIs. It can be concluded that these teachers had a generally positive attitude towards green skills, but not all of them saw them as suitable for vocational training at ITIs.

In summary, the analysis of the interviews indicates a wide-ranging spectrum of Indian VET teachers' subjective theories on green skills ranging from a lack of understanding to a more technical understanding, through a simple and pragmatic approach with green activities to a broader view involving green moral values (see Fig. 1). The more links teachers see between green skills and their trade and industry, the more positive are their attitudes towards them in vocational training. The spectrum of subjective theories is not rigid, and exhibits ambiguities, overlaps, and contrasts, with a predominant focus on technical issues in

Green skills as technical green skills	Green skills as green activities	Green skills as green moral values
Green energy and technologies Resource management Recycling and waste management Maintenance over disposal Safety and personal protection	Tree planting Public transport usage Resource conservation (e.g., water, electricity, paper) Waste collection and cleaning	Green mindset Environmental awareness Individual and public responsibility Long-term perspective SDGs Future generations

Fig. 1. Summary of Indian VET teachers' subjective theories on green skills.

relation to green skills.

5. Discussion

The following draws a comparison between the teachers' subjective theories on green skills and objective theories framed by supranational organisations and research. The main conclusions are summarised in Fig. 2. In addition, other salient findings of the interviews are discussed in the context of extant research results on VET in India, including the socio-cultural and professional backgrounds of teachers influencing their subjective theories.

Objective theories on green skills include, according to ILO (2015), ETF (2021), Pavlova (2022) and CEDEFOP (2024), *technical green skills* encompassing aspects such as resource utilisation and impact, resource consumption minimisation, waste, water and energy management, risk management, monitoring, procurement and selection. Most teachers' subjective theories align with these aspects. Teachers stated that technical green skills like waste management, massive use of resources and the 3 R principle are pertinent within the context of green skills as they have a strong direct connection to various technical trades and are also relevant for industries. The findings are similar to those of Hamid et al. (2019), Zolkifli et al. (2016) and Li et al. (2023), who identified green skills as being also largely associated by VET stakeholders with energy use efficiency, the 3Rs, waste management and safety regulations. Additionally, according to Pavlova (2022) and CEDEFOP (2024), green skills include the topping up of existing skills, particularly concerning the integration of emerging green technologies, machinery, or processes – an aspect frequently stressed by Indian teachers. Moreover, specific green skills are linked to emerging occupations, such as solar energy and electric vehicles, for which new training programmes at ITIs have been developed, as confirmed by some of the interviewees.

In addition, teachers' subjective theories on green skills encompass *green activities* of environmental protection with pragmatic and daily actions such as tree planting, paper conservation and waste collection; thus aligning with the Indian conceptualisation of green skills as simple, everyday environmentally friendly practices (Bishnoi and Rai, 2022; Mahapatra and Ravichandran, 2023). The finding is also consistent with the results of Rajput et al. (2021), who observed that Pakistani VET professionals connect green skills with tree planting and waste recycling. For this reason, an additional field has been added in Fig. 2. The activities mentioned by the teachers were presented as extra-curricular and carried out collaboratively by teachers and students at ITIs as part of the National Service Scheme. Participation in such community-based activities appeared to be particularly prevalent in the Bangalore region. While these initiatives can positively influence environmental awareness and behavioural patterns among teachers and students and should be continued and developed at ITIs, they do not significantly contribute to a holistic green transition of VET in India (Majumdar, 2011).

Objective theories on green skills also integrate *green moral values* (e.g., ETF, 2021; Pavlova, 2022; CEDEFOP, 2024), which are also reflected in some of the Indian VET teachers' subjective theories. These teachers extended the conceptualisation of green skills beyond technical or professional skills to include environmentally responsible values and attitudes. In alignment with the guiding principles of sustainable development (United Nations, 1992), these teachers also emphasised the responsibility of ensuring well-being for future generations through the conservation of natural resources, as well as addressing the ecological, economic and social dimensions of sustainability and their inherent contradictions. Furthermore, their explanations incorporated the principles of sufficiency, consistency and efficiency (Rudolf and Schmidt, 2025).

In addition to this, objective theories on green skills incorporate *soft or generic green skills*, encompassing cognitive, interpersonal, and intrapersonal competencies (ILO, 2015; ETF, 2021; CEDEFOP, 2024), deemed essential "for a modern [green] workforce" across all domains (Pavlova, 2022, p. 8). However, these skills were not mentioned by the teachers interviewed, which suggests that they are not integrated in their subjective theories on green skills. This may be attributed to the fact that soft skills such as problem-solving, critical thinking,

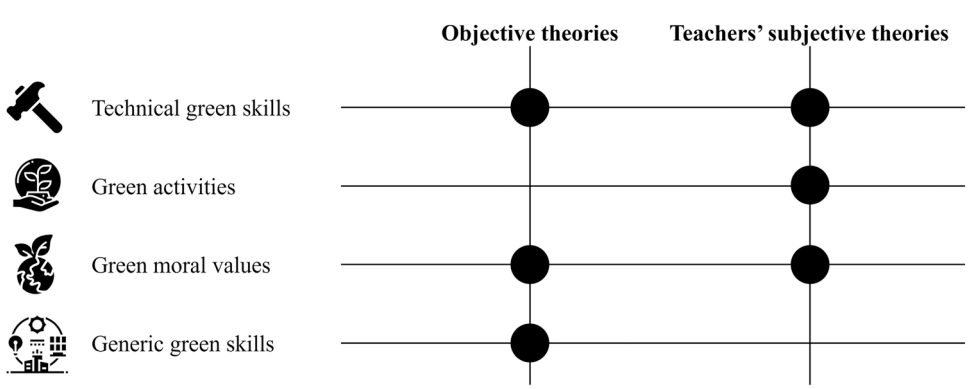

Fig. 2. Objective theories vs. Indian VET teachers' subjective theories on green skills.

independent decision-making – key components of generic green skills that foster a sustainability-orientated mindset – are generally not prioritised within ITI training programmes. This finding aligns with the results of Zenner et al. (2017) and Schneider et al. (2023), who reported that Indian ITI teachers think that skills and especially attitude cannot be taught at ITIs, but rather only theoretical knowledge. Thus, students adopt a passive stance rather than cultivating proactive behaviours (Schneider et al., 2023), which are, in fact, essential for the development of green skills. Consequently, generic green skills remain outside the Indian teachers' subjective theories.

Apart from objective and subjective theories on green skills, other outcomes from the interviews deserve further discussion. Some teachers pointed out that green skills should be included in higher education institutions, such as Polytechnic Colleges, or within the general education system rather than into training at ITIs. This perception implies that green skills are considered less essential for Indian professionals at the intermediate skill level engaged in manual or physical labour in blue collar jobs (Pilz, 2016), and more relevant for highly skilled professionals. Teachers justified this viewpoint by highlighting that ITI students often come from socioeconomically disadvantaged backgrounds, belong to lower castes and possess limited foundational literacy and numeracy skills (Ajithkumar and Pilz, 2019; Mehrotra, 2021). This educational stratification can be traced back to historical and systemic inequalities in India (Singh, 2001). Hence, green skills tend to be associated with intellectual occupations, typically performed by individuals from higher castes and with higher educational degrees (Vincent and Rajasekhar, 2023). This perspective aligns with the findings of Langthaler et al. (2021), who argue that green skills often require skills in science, technology, engineering and mathematics (STEM), making them more relevant for professions requiring higher qualification, and involve complex tasks and advanced technologies such as engineering.

Analysis of the interviews also revealed that teachers' backgrounds, experiences and local conditions shape their subjective theories on green skills. In more rural areas, green skills were frequently associated with agricultural practices and climate change adaptation, whereas teachers in urban settings, particularly in New Delhi, frequently referred to air pollution as a central environmental concern. This aligns with Nguyen et al. (2023), who identified internal factors, including teachers' experiences as a key determinant of their subjective theories. External factors such as the integration of green skills in teacher education programmes, the availability of instructional resources in local language and support from information technologies and media also play a critical role. A number of faculty members interviewed hold only an ITI diploma alongside a CITS qualification (Mathur et al., 2014), which can limit their prior exposure to green skills. The same applies to diploma holders: "When I did my diploma [at a Polytechnic], green skills were not a topic. So, I don't have a lot of knowledge about it, maybe from the news or when other people tell me something" (ITI_D2). This finding suggests that green skills are not firmly embedded in the teachers' prior education, resulting in varying subjective theories among them. Furthermore, the specific curriculum associated with a teacher's trade and subject has a particular influence on their conceptual understanding, as stressed by Borg et al. (2012) and Kougias et al. (2023). Many teachers interviewed specifically referred to the 5S concept as a framework for green skills, given its inclusion in ITI curricula. Additionally, national and local government policies, such as electric vehicle promotion initiatives, further shaped teachers' subjective theories as this statement underlines: "[Everything] has to come from the government" (ITI_B11).

Consequently, the integration of green skills into prescribed Indian curricula provides the basis for implementation of green skills in the classroom. According to some teachers, technical green skills should be integrated into technical curricula. In contrast, other teachers argued that green skills should be integrated into the overarching, cross-occupational subject of Employability Skills, which encompasses entrepreneurial, behavioural and communication skills (Schneider and Pilz, 2024). A curricular integration necessitates enhancing teacher qualifications through initial teacher education and continuous professional development (Schneider and Pilz, 2024) to ensure that teachers' subjective theories on green skills resemble objective theories.

Established scientific frameworks for teacher training in sustainable development and green skills already exist within the Asia-Pacific region (e.g., Kang and Pavlova, 2019; Pavlova and Chen, 2019; Chinedu et al., 2023). According to Diep and Hartmann (2016, p. 14), teachers require a "combination of professional expertise, pedagogical competencies and awareness of duties and responsibilities concerning environment protection". This could serve as a foundation for further developing VET teacher education in India.

6. Conclusion

Teachers' subjective theories on phenomena may differ from objective theories. Consequently, it is imperative to examine teachers' individual perspectives as these influence teaching and learning in the classroom. In this light, this study focused on Indian VET teachers' subjective theories on green skills with their conceptual understanding and attitude. The study's findings reveal that the teachers' subjective theories, influenced by both internal and external factors, cover a broad spectrum. Despite the lack of empirical representativeness of the interviewed teacher sample, the potential for socially desirable answers and research biases, recurring explanatory patterns suggest a prevailing trend in the subjective theories on green skills. In addition, parallels can be drawn with existing studies (e.g., Li et al., 2023).

The study focused mainly on ITIs in metropolitan areas, with future research extending this to include ITIs in rural regions to capture further regional variations in teachers' subjective theories. The current research design, consisting of interviews, could be expanded in the future to include reflective validation and further development of individual understanding, for example with a structure-formation technique (Goller and Markert, 2025). A preliminary document analysis suggests a lack of integration of green skills into Indian curricula and training materials; thus, future studies could address this gap by scientifically investigating these documents and comparing them with those of other countries, as exemplified by Chen's (2025) comparative study of China and Germany. The findings of this study have the potential to contribute to the subsequent development and expansion of curricula with green skills. This is not limited to the curricula at ITIs but extends to the training programmes of prospective VET teachers as well.

The bottom-up approach focusing on the micro-level, which is essential for a green transition of VET systems (Ramsarup et al., 2024), could be supplemented in the future with scientific studies that interview and observe teachers and learners regarding the implementation of green skills in the classroom. This study could not provide any information on the relationship between subjective theories and actual teaching practice in the context of green skills. In addition, the perspective of industry and potential employers of ITI graduates on green skills could be investigated; in addition to which, research could explore the role of other institutions within the Indian VET system, particularly Polytechnic Colleges, which were frequently referred to by teachers as being more aligned with green skills development. Finally, the greening of formal VET in India can only be realised if all stakeholders at all levels of the formal VET system are involved in the greening processes and these are taken up in the sense of a holistic approach rather than simply introducing isolated initiatives and private training programmes for green skills (Stroud et al., 2024).

CRediT authorship contribution statement

Annabell Albertz: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Matthias Pilz:** Writing – review & editing, Writing – original

draft, Visualization, Validation, Supervision, Resources, Methodology, Funding acquisition, Conceptualization.

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Declaration of Competing Interest

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