

Exploring the potential for enhancing green skills training, innovation and sustainable livelihoods in informal spaces of Harare, Zimbabwe: identifying gaps and opportunities

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Abstract

Purpose – Despite growing emphasis on green skills, innovation, and sustainable livelihoods, research remains limited in the informal economy, particularly in developing countries. This study investigates gaps in green skills training, innovations and livelihoods among informal metal fabricators, shedding light on the challenges and opportunities within this sector. Specifically, the study critically assesses the potential for upskilling informal metal fabricators through Technical and Vocational Education and Training (TVET) institutions and university innovation hubs.

Design/methodology/approach – Employing a qualitative interpretive methodology, we conducted 40 key informant interviews with small-scale informal metal fabricators operating in Magaba and Gaza home industries, two of Harare's largest home industries in Zimbabwe. Subsequent key informant interviews were held with TVET educators and innovation hub lecturers. Observations were carried out over a period of three months to comprehensively explore the issues under investigation.

Findings – Gender disparities persist within informal innovation spaces, with women making strides in the traditionally male-dominated field of metal fabrication. However, challenges such as prejudices, stigma, ridicule and abuse hinder women's full participation in manufacturing processes, often relegating them to less physically demanding roles like customer engagement and product marketing. Inequities in support for green skills training were evident, with the innovation hub model primarily catering to formally educated youth in universities, neglecting the active involvement of notable informal innovators with limited formal education. While a gradual shift toward renewable energy sources is observable in the informal economy, government-owned TVET institutions show minimal or no adjustments in course content to incorporate essential green skills. In light of the findings, the study proposes measures to ensure equitable green skills training, innovation and the promotion of sustainable livelihoods in the informal metal fabrication sector.



Originality/value – The findings of this study represent a novel contribution the gaps in green skills training in the informal economy and how these inform reforms for vocational learning and training practices and the incubation of innovations.

Keywords Livelihoods, Green skills, Informal economy, Innovation, TVET, Innovation hub

Paper type Research paper

Introduction and background

Informal vocational education and training [1] are often associated with the creation of new economic opportunities for the youths working in the informal economy in developing countries (Chea & Huijsmans, 2018; Manyati & Mutsau, 2021). A recent report notes that Zimbabwe has the second-largest informal economy [2] in the world, exceeding 60.6% of the economy. However, the green skills that informal innovators require for use, especially in emergencies such as the COVID-19 pandemic remain poorly understood in developing country contexts. Conceptually, the term green skills is often contested but this study will use the definition of green skills as, “the technical skills, knowledge, values and attitudes needed by a workforce to develop and support sustainable social, economic and environmental outcomes in business, industry and the community” (Ling & Xu, 2020; Palinkas *et al.*, 2013). The most common green skills include design skills, leadership skills, management skills, energy skills, city planning skills, landscaping skills, communication skills, waste management skills, procurement skills, and financial skills (Sern, Zaima, & Foong, 2018).

In Zimbabwe, there is increased emphasis on green skills training, innovation and sustainable livelihoods generation especially for the youth working in the informal economy (Manyati & Mutsau, 2021). On the African continent, 80% per cent of people, who are mostly youth, find work in the informal sector and 90% of the population is excluded from post-school qualification. Under such circumstances, the informal economy has offered spaces of inclusion and participation often better suited to accompanying young people into the world of work (Metelerkamp & Monk, 2023). Recent years have witnessed a spike in the emergence of TVET institutions managed by non-governmental organisations and local private colleges that are now offering innovative training courses tailor-made for the youth such as solar power installation. Additionally, in response to the evolving labour market needs, and the increased demand for graduates with industry-relevant skills, the Ministry of Higher and Tertiary Education in Zimbabwe introduced the Education 5.0 [3] policy as the primary mode of science, technology and innovation progress (Togo & Gandidzanwa, 2021). The Education 5.0 policy is centred on the salient principles of teaching, researching, community service, innovation and industrialisation (Alharbi, 2023). The policy has mostly been implemented in state universities in Zimbabwe resulting in the creation of six innovation hubs and industrial parks in state universities to promote entrepreneurship and technological advancement among graduates. (Alharbi, 2023). However, the policy neglected lower-level education outside formal university learning, renewing inequalities within the education system as TVET and informal learning and innovation were left behind in the implementation of the new initiative (Kudakwashe, 2021). To address this problem, a new TVET policy was recently approved to address the challenges that beleaguer TVET institutions such as revising the outdated training curriculum, introducing new courses and improving the accessibility of training programmes to vulnerable populations such as those working in the informal economy (Metelerkamp & Monk, 2023). However, with the implementation of the TVET policy still in its infancy, decentralised training models are urgently required to improve the reach and impact of skills training courses for the marginalised youth working as informal metal fabricators.

Although previous research studies have explored the adaptation of restorative practices by large formal companies and industries, data is still limited to green skills training in the informal economy [4] (Dey *et al.*, 2020). Skills training within the rural areas and the informal economy also remains neglected (McGrath, 2022). The educational and training needs of the most vulnerable populations such as women who are over-represented in the informal economy remain neglected (Avis, Atkins, Esmond, & McGrath, 2021; Ojo, 2020). Recent studies have pointed out that there is a need for a deeper understanding of the processes, inequalities and power relations that characterise the eco-systems of skills training (Allais, 2022). This study explored the gaps in green skills training, innovations and livelihoods generation of sustainable livelihoods informal metal fabricators. Additionally, the study makes a grim reflection on the opportunities for upskilling of informal metal fabricators by TVET institutions and university innovation hubs.

To explore these research objectives this study attempted to answer the following questions.

- RO1. What are the gaps in green skills training, innovations and livelihood generation among informal metal fabricators working in informal spaces?
- RO2. What are the opportunities for green skills training by TVET and innovation hubs in informal spaces?
- RO3. How can the gaps in green skills training, innovation and sustainable livelihoods be addressed?

In response to these research questions, this paper applied a qualitative interpretive methodology to collect primary data from small-scale manufacturers, TVET and innovation hub lecturers and government ministry officers. Thematic analysis was used to analyse recurrent themes emerging from the data (Castleberry & Nolen, 2018). A bottom-up approach to the study of skills, innovation and livelihoods was particularly important for this study considering the weak or absence of specific empowerment and skills training interventions targeting the youth working in the urban informal sector. The empirical results of this study represent a novel contribution that will inform reforms of the TVET practices and the incubation of innovations that may help to facilitate social justice in skills training and the generation of sustainable livelihoods among small-scale metal fabricators operating in informal spaces.

Materials and methods

Research design

A qualitative interpretive methodology was used for this study. This approach was appropriate for this study as it enabled the researchers to uncover the gaps in green skills training, innovations and livelihoods generation of informal metal fabricators. The opportunities for upskilling by TVET institutions and innovation hubs were also examined. The interventions that are required to ensure inclusive green skills training innovation and sustainable livelihoods were also suggested.

Methods

Key informant interviews (KIIs) with informal innovators were conducted from January to March 2022. KIIs were particularly appropriate for exploring the experiences, and perspectives of the informal innovators. In addition, KIIs were also done with TVET lecturers, innovation hub mentors and government officers. Through these interviews, the researchers were able to obtain first-hand information and expert knowledge about skills training, livelihoods and innovation in the informal economy.

Procedure

The lead author first conducted KIIs with informal innovators at Mbare and Gaza Home Industries, two of the largest home industries in Harare, Zimbabwe. The lead author also observed Innovation Exhibitions and the innovation and manufacturing processes that occur within the informal economy. KIIs were also conducted using the local language Shona or English for three weeks in April 2022 in Harare, Zimbabwe. KIIs were also done over 2 weeks in May 2022. To ensure maximum participation and sharing of data, rapport was established with all participants and all KIIs were guided by an interview guide with a series of questions guiding the discussion and respondents were comfortable in answering, as their anonymity was guaranteed. Each session lasted for about 25 to 30 minutes.

Participant selection

Purposive sampling was used to select participants for KIIs for this study (Ames, Glenton, & Lewin, 2019). Purposive sampling was particularly important for identifying information-rich participants with first-hand knowledge and experience about skills training, innovation and livelihoods in the informal economy. After identifying and completing an interview with a knowledgeable participant, we were then referred to other participants through snowball sampling. The selected participants referred us to other participants who were well-versed in the subject matter under investigation. Participants that were selected for this study include those who are currently teaching in TVET institutions, departmental heads and innovation hub mentors. Interviews were conducted until theme saturation was achieved – a situation where no new themes emerged from the data (Guest, Namey, & Chen, 2020; Saunders *et al.*, 2018). After every interview, the researchers summarised the key findings and identified new questions for probing. After 40 interviews, no new information emerged and data collection was stopped. The researchers then proceeded to interview TVET lecturers and a government official. The data collected in this study was summarised in Table 1 below.

Data analysis

Data were analysed using thematic analysis. The researchers decided to use the thematic analysis because of its ability to provide a rich and detailed account of data (Nowell, Norris, White, & Moules, 2017; Castleberry & Nolen, 2018). The initial data analysis stage involved the reading of the interview transcripts generated during data gathering. All the interviews were transcribed and translated verbatim. A thorough reading of transcripts allowed the researcher to be immersed in the data, which increased familiarity with the depth and breadth

		Departments/Occupations	Number of participants
Institutions	University	Innovation Hub	4
		Informal Economy	Metal Fabrication
		Re-smelters	10
		Innovators	10
		Metal Waste Pickers	10
	Technical Vocational Education and Training Government	Motor Mechanics lecturers	4
		Ministry of Gender, Youth and Small and Medium Enterprises	1
<i>Total</i>			47

Source(s): Table generated by the authors of this study

Table 1. Summary of participants included in the study

of the data sets. Immersing oneself in the data allowed the researchers to have a deep understanding of the underlying issues in the study. The data critical features were systematically coded, and relevant data coalesced to each code. Thirdly, codes were collated into tentative themes. Theming entailed drawing codes from transcripts to create coherent meanings and findings from the data in line with the research objectives. At this stage, all data related to each theme were grouped accordingly. As such, some codes formed either main themes or sub-themes or were discarded. This was followed by defining and naming the themes relating to the analysis of the research and literature.

Ethical considerations

Ethical approval to conduct this research was granted by the University of South Africa College of Economic and Management Ethics Committee (Protocol Number: 2019_DE_006). The researchers applied for permission to conduct the research from the Harare City Council Human Capital Office for permission to carry out the research at Mbare Siya So and Gaza Home Industries. Another application was submitted to a TVET institution and a university hub in Harare, Zimbabwe.

Results

The presented results outline the outcome of an investigation that encompassed 40 in-depth interviews with informal innovators to comprehend the dynamics of skills training, innovation, and livelihoods within the informal economy. The interviews were conducted within a specific time frame, ranging from January to March 2022, for the informal innovators, and during April 2022 for the key informants. The participant characteristics for both groups are presented in [Tables 2 and 3](#) below.

Demographic characteristics of the key informants

A summary of the key informant participant characteristics (TVET lecturers and government officers) is summarised in [Table 3](#) below.

A total of 7 participants drawn from TVET (57.1%), Innovation hubs (28.5%) and Government (14.2 %) were interviewed for this study. 71.4% of the participants were male and 28.5% were female. Most of the participants selected for this study were experienced and well versed with the informal with 42.8% of the participants having work experience of 15 years or more whilst 57.1% had between 11 to 15 years of work experience.

Discussion

The central inquiry of this study was, What are the gaps in green skills training, innovations and livelihoods generation among informal metal fabricators working in informal spaces? What are the opportunities for green skills training by TVET and innovation hubs in informal spaces? How can the gaps in green skills training, innovation and sustainable livelihoods be addressed? Employing thematic analysis, we elucidated recurring themes concerning green skills training deficiencies in the informal economy and the potential for enhancing skills to achieve sustainable livelihoods. [Table 4](#) presents a condensed overview of the resultant emerging themes.

Skill gaps in the financial management of informal firms

First, we noted that informally trained manufacturers and firm owners often lack the financial literacy skills to manage their enterprises sustainably, with speculative and reactive activity to foreign to local currency exchange rates dominating trade and financial decision-making. Previous studies also note that the main sources of contention in transaction

Demographic variables	No	%	Potential for enhancing green skills training
<i>Gender</i>			65
Male	35	87.5	
Female	5	12.5	
<i>Age</i>			
<16 years	5	12.5	
16 to 35 years	30	75	
>35 years	5	12.5	
<i>Education</i>			
On-the-job training	10	25	
High school	20	50	
College	8	20	
University	2	5	
<i>Years of work experience</i>			
5 years or less	10	25	
6 to 10 years	11	27.5	
11 to 15 years	14	35	
15 years and above	5	12.5	
<i>Position in the organisation</i>			
Firm Owner	5	12.5	
Senior/Experienced metal fabricator	14	35	
Inexperienced metal fabricator	11	27.5	
<i>Size of enterprise</i>			
Micro-business	40	100	
Small enterprise	0	0	
Medium sized business	0	0	
<i>Sector of the organisation</i>			
Manufacturing	0	0	
Service	0	0	
Manufacturing and service	40	100	

Table 2.
Demographic characteristics of the participants (informal innovators)

Source(s): Table generated by the authors of this study

exchanges involve currency conversion exchange rates from the United States Dollars (USD) to the local RTGs and vice versa, and the issue of bank charges (Gukurume & Mahiya, 2020).

Additionally, the methods of recruitment and training in the informal economy are mostly based on social connections and relations, neglecting skills and competencies resulting in the influx of unskilled, inexperienced labour thus constraining the competitiveness and innovation within the sector. Under this arrangement, young women who are brought into the informal workspaces face the challenge of being segregated into particular roles that are deemed fit for women as patriarchal notions from society are imported into the workplace. Previous studies also noted that recruitment of jobs in the informal economy was tied to family and friendship connections (van der Walt & Whittaker, 2020). The informal training system of training often neglects training on skills for the management of funds, existing mostly for survivalist livelihoods.

Young innovators with a history of formal education displayed innovation with the restructuring of their business during the COVID-19 lockdown such as crowd gatherings in their home backyards to continue their operations during the emergency, online sourcing of raw materials and online marketing of finished products through platforms such as What's App Business Accounts in search of new markets, the older manufacturers and some

IJSBI 2,1	Demographic characteristics	
	No	%
66	<i>Gender</i>	
	Male	55.5
	Female	44.4
	<i>Age</i>	
	<18 years	0
	18–35 years	22.2
	36–50 years	66.6
	>50 years	11.1
	<i>Years of work experience</i>	
	0–5 years	11.1
	6 to 10 years	11.1
	11 to 15 years	44.4
	15 years and above	33.3
	<i>Position in organisation</i>	
	Head of department	22.2
	Lecturer	77.7
	Junior lecturer	0
	<i>Education</i>	
	College	66.6
	University	33.3
	<i>Sector of employment</i>	
TVET	44.4	
Innovation hub	44.4	
Government	11.1	
Table 3. Demographic characteristics of key informants	Source(s): Table generated by the authors of this study	

informal innovators lacked the skills to adopt to the new working arrangements during the COVID-19 lockdown, opting to maintain their usual walk in customers base and spaces resulting in reduced sales, working hours and livelihoods which threatened the existence of their businesses.

Mechanisms for addressing financial skills gap

To close this skills gap, TVET needs to design and deliver flexible short sector-specific training that capacitates informal innovators on sustainable financial management and literacy for prudent and cost-effective resource use in informal spaces. Additionally, TVET need to structure design and train the youth working as informal metal fabricators with skilling training of young informal metal manufacturers with online marketing skills for improved livelihoods and enlarged customer base may help improve livelihoods. Informal innovators also require training for the creation of sustainable crowdfunding structures among other local mechanisms that enable them to fundraise funds for the empowerment of neglected informal economy and other social groups such as women.

Gender inequalities and innovation in informal spaces

Gender disparities persist in informal innovation spaces, as women make inroads into the historically male-dominated realm of metal fabrication within the informal economy. Embedded biases, stigma, ridicule, and abuse continue to hinder women's involvement in

Main theme	Sub theme	Description
<i>Gaps in green skills training</i>		
Financial management	Weak Management skills	Informal Innovators lack the skills for the management of funds
	Survivalist Culture	Informal Innovators not futuristic in their management of resources, focussing on immediate circumstances
Design skills	Gendered division of roles	Men associated with creativity and expected to manufacture with women confined to marketing
Inequalities and innovation	Gendered roles	Men mostly associated with innovation and creativity
	Gendered innovation process	Men associated as creators of products and women consumers
	Gendered ownership of innovations	Men mostly associated with ownership of innovations and women as marketers
	Gendered Prejudices	Informal manufacturing spaces mostly perceived as a male territory
Centralised skills training	Weak Outreach Components	Absent of decentralised training programs for Informal Innovators
	Difficulty in access finance for innovations	Long period for securing investment for bankable innovations
	Exclusion of informal innovators	Informal Innovators not integrated within the Innovation System
	Lack of recognition	Informal innovations mostly not recognised for further development
	Time consuming formal training	Lengthy mentorship process in informal hubs discourages active participation
	Lack of Knowledge	Informal innovators lack knowledge about opportunities for green skills training
<i>Opportunities for green skills training</i>		
Skills trainings	Short TVET Courses	Introduce short training programs on green skills
	On the job mentorship	Implement on the job trainings targeting the youths
	Upskilling of TVET trainers	Provide up skilling trainings for TVET trainers
	Decentralised TVET	Structure TVET to engage the youth working in informal spaces
	Placements for TVET trainers	Formalise the attachment of TVET trainers in green industries
	Community Outreach	Structure innovation hubs to mentor informal innovators
<i>Addressing green skills gaps</i>		
Curriculum review	Align TVET to Education 5.0	Align all TVET training courses to Education 5.0
	Greening TVET Courses	A revision of the TVET programmes to incorporate green skills
	Renewable Energy Courses	New renewable energy centred training courses
	Integrated Women Centred Innovation	Design and implement integrated women centred innovation
	Value Addition Programmes	Introduce value addition components across all TVET courses

(continued)

Table 4. Summary of emerging themes

Main theme	Sub theme	Description
Policy and regulatory framework	Green Skills Policy Framework	Crafting of a green skills policy framework
	Promote Green Technology	Promote the adoption of green technology by informal metal fabricators
	Revising Current Innovation Policy	Revising the current innovation policy
	Green Awareness	Disseminate information about green manufacturing processes
	Effective waste disposal	Implement effective waste disposal systems in informal spaces
Collaboration and learning	Recycling	Adopt the recycling process in informal spaces
	Green Skills Ecosystem	Collaborative green ecosystems among diverse institutions
	Inclusive Innovation Process	Implement inclusive innovation systems that include informal innovators
	Strategic Partnerships	Leveraging partnerships to unlock funding
Funding and support	Expedited Innovation processes	Speed up the incubation cycle for maximum participation by informal innovators
	Import exemptions	Import exemptions for the purchasing of green technologies and equipment
	Strategic Investments	Investment in a local knowledge base and technological capabilities
	Women's Advocacy	Gender movement for women's empowerment in informal spaces
	Crowdsourcing Structures	Crowdfunding of resources to fund a green transition
	Expedited State grants	Expedited state grants for the empowerment of informal innovators

Table 4. Source(s): Table generated by the authors of this study

innovation and manufacturing within informal settings. Women are often confined to less demanding and socially acceptable roles, such as procuring raw materials, engaging customers, and marketing finished products. Despite being the originators of many innovative concepts, women remain excluded from technology development for value-added agricultural products.

In small-scale informal spaces where innovative agricultural technologies like gravity-driven dehullers are crafted, male innovators predominate, with women's input primarily manifesting as intangible intuitive insights during co-creation interactions with male manufacturers. Substantially limited participation of women is apparent in agricultural technology innovation and production. Moreover, the weak position women occupy within the innovation and value chain is notable, and gender-based movements that support, defend, and commercialise female ideas are conspicuously absent in informal domains.

Consequently, innovations and technologies emanating from informal spaces often serve as tangible representations that showcase "male creativity" and embody an expression of "male power" due to their pronounced male involvement. This skewed innovation process disempowers women, denying them ownership of their innovations and decision-making authority. Women remain confined to roles as recipients of finalised agricultural technologies, primarily due to their predominant presence as labourers in small-scale rural farming.

Additionally, female TVET lecturers with prior industry experience recounted enduring deep-seated prejudices, stigma, ridicule, and abuse, which prompted some to exit "unsafe

spaces” in the informal industry and opt for safer positions in academia. The gendered division of labour, grounded in patriarchal ideologies and cultural norms that cast women as weaker and more suitable for labour-intensive roles, perpetuates through educational institutions and workplaces. Earlier studies also underscore gender disparities in informal innovation processes (Manyati & Mutsau, 2020b, 2019; Manyati, 2014).

Mechanisms for addressing inequalities within the innovation process

Addressing gender imbalances in informal skills training necessitates integrated women-centred innovation and value-addition programs that empower females to overcome barriers inherent in labour-intensive manufacturing within informal contexts. Moreover, the establishment of gender-oriented movements to champion, safeguard, and commercialise female ideas is imperative to ensure equity in innovation processes. Launching inclusive and environmentally conscious programs targeted at youth engaged in small-scale manufacturing can challenge biased gender stereotypes prevalent in informal innovation processes and foster a favourable perception of women’s competencies in labour-intensive manufacturing.

Skills training gap within informal spaces

Thirdly, we noted that despite evidence of incremental innovations being developed in the informal economy, informal innovators lack localised skills trainings and interventions from TVET, non-governmental organisations and innovation hubs. Interviews with informal innovators working in informal spaces at Gaza Home Industry noted that NGO skills training interventions targeting urban informal innovators were completed more than 20 years ago.

We have not received any skills training for a long time. They used to be an NGO that used to assist us with machinery and skills training but the project ended sometime around 1998

Apart from the few formally trained manufacturers who establish their firms in the informal sector, there is very little progression in terms of skills development and innovation among informally trained manufacturers. Most of the informally trained manufacturers interviewed displayed very little capacity and willingness for innovation, preferring to manufacture the same products as long as walk-in customers were available.

Mechanisms for addressing skills gaps

To deal with the skills gap within the informal innovation processes in the informal economy, non-government organisations (NGOs) and government should resuscitate up-skilling training programmes and support that will capacitate informal innovators to respond to community needs and demands. Whilst innovation hubs and TVET are largely campus-based, NGOs might seize the opportunity to fill the void and complement TVET with community-based on-job training, mentorship and support schedules for informal innovators in green skills training, problem framing, ideation, prototyping, implementation and scale-up of new products within informal spaces. In addition, there is a need to support informal innovators with machinery and the necessary skills and demonstrations to facilitate inclusive participation within manufacturing processes in informal spaces. Furthermore, whilst the slow onset transition towards the use of renewable energy sources is evident in the informal economy, private colleges that have introduced short training programmes in renewable energy sources such as solar and biogas, very little or no change in course content to incorporate green skills were observed in government-owned TVET institutions aimed at empowering the youth working in the informal economy. In [Table 5](#) below, the following training programs gaps were noticed as being offered in renewable energy TVET for

Societal problems and needs (community Level)	Gaps in green skills training (informal economy)	New green skills courses (renewable energy TVET)
<ul style="list-style-type: none"> • Frequent electrical power outages that negatively affect households and commercial entities • Increased pressure on electricity • Poor organic waste management in urban areas due to population growth • Scarce conventional energy sources such as electricity in rural areas • Poor quality of life due to energy shortages • Poor waste disposal system • Limited appreciation of recycling and reusing • Poor organic waste management in urban areas due to population growth • Scarce conventional energy sources such as electricity in rural areas • Precarious livelihoods • Social hardships • Inflationary economic environment • Hand-to-mouth livelihood generation • Culture of spending • Sub-optimal use of agricultural technology by small-scale rural farmers • The high cost of agricultural technology • Lack of skills and knowledge to integrate technology in farming areas 	<ul style="list-style-type: none"> • Design, Installation and Maintenance Skills for alternative power sources • Solid waste management skills • The capacity to design biogas production equipment • The skills for establishing small-scale biogas digesters • Skills for processing the waste product from biogas digesters into organic fertilisers • Different waste recycling techniques • Skills for operating a successful waste recycling business • Appropriate building skills for the various stages of Biogas Construction • Skills in constructing Modified Camartec Domestic and Solid State Domestic biogas design types • Poor financial management and record-keeping • Poor financial literacy • Poor online marketing • Poor regional markets • Poor investment strategy • Poor strategic partnerships • Poor recruitment strategies • Installation of Drip irrigation systems (automated or manual) • Greenhouse construction 	<ul style="list-style-type: none"> • Solar Installation and Technology • Small-scale biogas production • Waste Management and Recycling • Biogas masonry building course • Business entrepreneurship course • Greenhouse construction and installation

Table 5. Gaps in green skills training and opportunities for upskilling for TVET

Source(s): Table generated by the authors of this study

improved employability, self-sustenance and entrepreneurship, social impact and capacity building of skills that respond to the market demands and societies needs that may help to inform the programs of government-owned TVET institutions to adopt to contemporary environmental concerns.

In addition, the hierarchy of knowledge and training systems is apparent within training systems with investments in skills training and innovation concentrated mostly within university innovation hubs, neglecting TVET which is closely connected to the informal economy and local communities. Currently, there is little evidence of green processes and green skills training programmes in local TVET colleges apart from the use of dysfunctional

engines obtained from the informal economy for learning and demonstrations. In addition, there is very little evidence of green skills training in local TVET institutions to match the transition towards green processes such as recycling, re-smelting, closed loops such as repairs, and narrow loops such as reusing are widely used. Whilst COVID-19 has triggered reflections on new ways of learning, there has been very little evidence observed of up-skilling interventions targeted at TVET lecturers for transferability to informal innovators to match the new skills demand and the changing realities within the informal economy.

To dismantle the exclusions and hierarchisation of knowledge and training systems rooted mostly in colonial educational philosophies and to foster social justice in training systems, we recommend the upskilling of TVET lecturers with skills for problem framing, ideation, prototyping and implementation of innovations for transferability of skills to the informal economy. Consequently, TVET training courses should be revised to align with the Education 5.0 policy to incorporate innovation and green industrialisation skills. Additionally, we also recommend the upskilling of TVET lecturers on green skills on recycling and the use of renewable energy sources for cleaner processes and the transferability of skills and knowledge to informal innovators. We also note that upskilling of TVET lecturers with new green skills such as cost-effective, clean and less pollutant recycling operations might be key.

Inequalities in the skills training and innovation

The researchers noted that the outreach component of innovation hubs neglects innovation in the informal economy, targeting mostly formal institutions such as university students, private companies, government and industry to showcase innovations and for engagement in high-level dialogues. One key informant commenting on an exhibition program at a local university said

The innovation exhibition is important as it will allow researchers, students and partners in government and industry to exhibit their innovations (INN- HRE- 001, Key Informant Interview),

The innovation model, as reflected in the comment above, as adopted by the universities is informed by the triple helix approach that focuses on universities, industry and government and economic exchange values, neglecting the informal economy, local communities and the human-centric values and practices that feed into the problem framing and ideation phases of the innovation process and thus hindering the later implementation of innovations that are grounded in local experiences, perpetuating inequalities within the innovation processes. Previous studies also confirm that informal innovations generate use value, socially embedded reciprocal and co-creation exchange values, and relational and non-relational intrinsic values (Sheikh & Bhaduri, 2020).

In addition, we also noted informal innovators are ignorant of the opportunities for up-skilling within innovation hubs and thus miss opportunities for training and mentorship opportunities during the innovation process. Increased community awareness campaigns and engagement of informal innovators about the existence of the innovation hubs, the mechanisms of enrolling and incubation of ideas and the benefits may contribute to the transferability of skills to the informal innovators. During an Annual Innovation Exhibition held at a local university in July 2022, the lead researcher observed evidence of green products designed by local innovators such as solar-powered curing machines aimed at reducing deforestation by tobacco farmers and seed planters. However, informal talks with the innovators revealed that the manufacturing processes that yield these products were not oriented towards sustainability. Up-skilling of innovation hub mentors on green value creation and processes might be key for the transferability of skills to innovators and a careful step forward in the establishment of green innovation hubs.

Additionally, informal innovators miss up-skilling training opportunities within university innovation hubs due to inflexible training schedules that do not conveniently decentralise to informal working spaces. During the same Innovation Exhibition, the lead author observed that the profiles of most of the participants were young, male innovators with a history or currently enrolled within tertiary institutions with limited or no representation of informal innovators. One lecturer with a background in Agricultural Economics.

Currently, our research focuses mostly on universities and formal institutions. You won't find the informal sector here

The innovation hub model and platforms are thus not immersed within the complexities and realities of the informal economy and the local communities and thus exclude the active participation of informal innovators of note with limited formal education. These findings concur with previous studies which note that the focus of innovation systems has largely been on the large-scale commercialisation of innovations in formal institutions, overlooking the unique structure of African economies that is dominated by the informal economy (Manyati & Mutsau, 2020a; Sheikh, 2019; Mustapha, Petersen, Jegede, Bortagaray, & Kruss, 2022; Rivera-Huerta & López-Lira, 2022).

Mechanisms for addressing inequalities in the innovation process

To deal with the inequalities in the incubation of ideas, skills training and innovation, university innovation hubs should establish mechanisms and platforms for identifying scalable ideas among informal innovators and introduce community outreach structures for flexible mentorship and training for innovation processes may contribute to the transferability of skills by innovation hubs to the informal economy. Reforms for the community outreach component of university innovation hubs are required for improved engagement and transferability of skills for innovation to informal innovators for improved quality of products and services. Sector-specific training on how informal innovators can draft and submit their ideas on innovations for consideration within innovation hubs may also help to bridge the divide between the informal economy and university innovation hubs, i.e. submission of demonstration videos using digital platforms such as WhatsApp.

Additionally, a few of the educated informal innovators who managed to enrol within innovation hubs expressed their reservations about the duration of the mentorship and training opportunities within university innovation hubs are time-consuming and take a long period for innovators to secure investment for the implementation of the innovations. This situation conflicts with the deep-seated operations of informal innovators who need to operate daily to maintain their precarious livelihoods. Accelerating the incubation of ideas within the innovation hubs may help to attract informal innovators to avoid disruption of their precarious livelihoods. The university innovation hubs phased enrolment procedures may be inadequate to accommodate the vast number of informal innovators and entrepreneurs that constantly flock to the informal economy resulting in the exclusion of promising informal innovations. With no green campuses available in Zimbabwe, innovation hub lecturers may lack the capacity and skills to effectively mentor informal innovators and students with skills for green processes and renewable energy use.

Study limitations and areas for future research

This study was based mainly on qualitative data about the gaps in skills training and innovation in the informal economy and the opportunities for equitable training and improved livelihoods. However, the data presented in this study is only indicative of the

dynamics prevalent in the sector and might not be generalisable to other contexts and settings. The study recommends the use of surveys in future studies for the generalisability of the findings and policy impact. This study also focuses mostly on informal innovators who engage in the metal fabrication sector. Future studies may need to explore the specific gaps in skills training in the range of occupations present in the informal economy such as dressmaking, textiles, agribusiness and basketry, tinsmith, information and communications technology, manufacturing, hairdressing, construction and auto mechanics among others. Such findings can inform a vocational pedagogy for environmental sustainability for TVET students.

Furthermore, this study focused on exploring mostly specific green skills such the financial, energy and design skills. Future studies may need to explore other dimensions of green skills that impact the informal economy that were not covered in this study such as leadership, management, city planning, landscaping, communication, waste management, procurement, and financial skills for informing a holistic transformation of the TVET curriculum and the impartation of green skills. This exercise entails the inclusion of additional subgroups such as TVET lecturers, disabled persons, and rural-based labour for a further examination of upskilling opportunities. Additionally, this study notes that the triple helix approach that informs innovation platforms in Zimbabwe has only considered how formal institutions such as universities, industry and the formal sector firms work together to drive innovation, overlooking grassroots innovations. This study recommends that future studies should consider the development of new theories for social innovation based on empirical evidence which includes informal innovators, local communities and customers within the innovation platforms.

This study documented critical green skills that can be integrated by TVET to empower the youth who are working in informal spaces (see Table 6). However, this is just a small piece of the puzzle as more research is required to explore potential green skills that are required for the utilisation of other rarely used renewable sources of energy in Zimbabwe such as wind and geothermal energy. Additionally, as demonstrated above, green skills training is often designed and delivered by TVET are compartmentalised with very limited research and experimentation done to date that explores how diversification or integration mixes of green skills can be effectively tapped for the social transformation of local communities. i.e. introduction of innovative training programs that combine expertise in solar, biogas and wind energy skills for maximum harnessing of the utilising of renewable energy especially in rural areas. Such expertise can translate into new innovative products and services that solve the social economic and environmental challenges that local communities are currently grappling with in a much more sustainable way.

Skills	Type of skills
Design, installation and maintenance of solar panels	Technical Competence
Waste recycling techniques	Technical Competence
Financial literacy	Generic Skills
Digital marketing	Generic Skills
Human resources management	Generic Skills
Greenhouse construction and installation	Technical Competence
Design, and maintenance of biogas equipment	Technical Competence
Biogas masonry design and construction	Technical Competence
Automated and manual drip irrigation installation	Technical Competence
Communication skills	Soft Skills

Source(s): Table generated by the authors of this study

Table 6. Green skills training opportunities for informal innovators

Practicality: Implications of the research results

TVET and university innovation hub learning. Firstly, the research results present insights into how green skills training can be mainstreamed into TVET learning. The study suggests potential courses that can be introduced into TVET learning, which provides an opportunity for upskilling and for improved products and services provided with a keen sense of environmental responsibility. The appropriate models for the delivery of TVET learning and Innovation hubs to reach and empower the marginalised metal fabricators that operate in the informal economy with new competencies, helping to solve gender disparities and social inequalities that characterise the education system in Zimbabwe through improved accessibility of the programmes. The integration of green skills in TVET and university innovation hubs will also help to improve the quality of education that will have relevance to industry, solving the problem of skills-work mismatch. Secondly, the research study also highlights opportunities for upskilling for TVET lecturers and innovation mentors in the area of green skills (see Table 4), which will in turn facilitate vocational pedagogy for environmental sustainability.

Academia. The study provides new knowledge about the processes, inequalities and power relations that characterise skills training. In the process, the study established the gaps in green skills training, innovations and livelihoods generation of sustainable livelihoods by informal metal fabricators in Zimbabwe. Additionally, the study makes a grim reflection on the opportunities for upskilling of informal metal fabricators by TVET institutions and university innovation hubs. The evidence presented in this study can be used as an academic point of reference and new knowledge for scholars and future researchers in the field of green skills, informal economy and innovation. This study highlighted the grey areas and controversies associated with green skills, innovation and the informal economy and provided future scholars with an opportunity to conduct further research in the field.

Policy. This research study provided insights into how the TVET and innovation hub model can be revised for the mainstreaming of green skills and sustainability issues into learning and practice, a critical step in the evolution of the education sector towards sustainable practices. Further, the research also highlights measures for ensuring epistemic justice where individuals across gender, age and class authentically contribute to social pools of knowledge during the innovation process. Additionally, the study recommendations provide evidence to policymakers and education specialists with insights into how the educational curriculum should be transformed for practical relevance in addressing societal problems. This research study assisted by recommending policies and procedures that can be used to improve the quality of the largely neglected TVET learning, fostering environmental and social justice.

Community. The deployment of green skills by the largely dominant youth working in the informal economy will help to facilitate the social transformation of local communities. Such expertise can translate into new innovative products and services that solve the social economic and environmental challenges that local communities are currently grappling with in a much more sustainable way. Local communities will also have an opportunity to purchase environmentally friendly products, increased awareness of environmental sustainability issues and the widespread appreciation and use of renewable energy sources.

Conclusions

In conclusion, this study underscores the presence of significant gaps within informal training systems, acting as impediments to the equitable advancement of skills, innovation, and sustainable livelihoods. These gaps, in turn, create a strategic opening for intervention through Technical and Vocational Education and Training (TVET) initiatives and university-driven innovation hubs. Despite the increasing ingress of women

into the historically male-dominated sphere of metal fabrication within the informal economy, the persisting undercurrents of prejudice, stigma, mockery, and mistreatment persistently hem them into roles considered less demanding and societally acceptable. This confines women to tasks such as raw material procurement, customer interaction, and product promotion, relegating them from active participation in the more intricate aspects of manufacturing processes. The gradual inroads toward adopting renewable energy sources within the informal economy and private educational institutions, characterised by the introduction of succinct training modules spotlighting solar and biogas technologies, remain in stark juxtaposition to the inertia observed within government-owned TVET establishments.

The dearth of integration of green skills into the curriculum raises pertinent questions about the sector's preparedness for the evolving demands of sustainable practices. Evident disparities in support for cultivating green competencies further emphasise the bias inherent in the innovation hub model, which predominantly favours formally educated youth in university settings. This predilection neglects the experiential wisdom and insights of informal innovators, often possessing limited formal education yet deeply entrenched in the intricate fabric of local communities and economies. In light of these findings, a set of recommendations emerges to illuminate the path towards progress. These recommendations encompass fostering enhanced access to green skills training within informal sectors, catalysing the assimilation and modernisation of technology and infrastructure, heightening awareness regarding green proficiencies and environmental sustainability, and engineering policy and regulatory frameworks conducive to the inclusive incubation of concepts, products, and expertise. By heeding these suggestions, a more inclusive and sustainable platform for livelihoods can take root, encompassing a diverse tapestry of ideas, products, and knowledge that mutually thrive and endure.

Recommendations for improved innovation and green skills training
Access to green skills training.

- (1) Informal metal fabricators
 - Incentives for training of the youth working in informal spaces as metal fabricators.
 - Introduction of short training programs targeting the youth that are working in informal spaces that incorporate green skills training for small-scale metal fabricators.
 - Introduce outreach up-skilling programmes for the youth working as metal fabricators in informal spaces.
- (2) TVET and Innovation Hub Instructors
 - Upskilling of TVET instructors and innovation hub personnel on green skills.
 - Attachment of TVET lecturers in industries using green practices for transferability of skills to the youth in the informal economy.
- (3) Policy and Regulatory Support
 - Government level reforms
 - There is a need to craft a policy framework to facilitate the transition towards sustainable manufacturing.

- There is a need to review the innovation policy in Zimbabwe to incorporate informal metal fabricators and local communities to facilitate industrialisation from below
- Curriculum review of all training programmes offered by TVET to incorporate innovation, creativity and green skills training
- Incorporate technical advice from universities, TVET, Industry and the local communities in the development of green skills training programmes.
- Local Authority regulatory reforms
 - Local authorities should design regulations that support and incentivise informal manufacturers to adopt green practices.
 - Launch local campaigns to raise awareness about the benefits of green practices to customers and informal metal fabricators.
 - Establish green workshops and enforce regulations that promote green practices in the operations and waste disposal systems of small-scale metal fabricators
- Non-governmental organisation support
 - Gender and Social Justice oriented programmes that promote, protect and commercialise female ideas in the informal sector
 - There is a need to facilitate green skill training programs that capacitate women to work in the manufacturing of products.
 - Partner with local authorities in the establishment of smart workshops with the essential green infrastructure, technologies and services that enable women to participate in small-scale manufacturing and innovation processes.
 - Creation of women networks and structures that enable transferability of ideas, skills, finance and market intelligence for the empowerment of the neglected informal economy.
 - Implementation of awareness programs that challenge gender stereotypes and promote a positive perception of women's creativity, resilience and capabilities in labour-intensive manufacturing.
- Collaboration and Learning
 - Creation of a supportive and collaborative skills ecosystem that connects informal metal fabricators.
 - Strategic partnerships that help unlock funding
 - Strategic partnerships between informal metal fabricators technical expertise with TVET lecturers and innovation hubs mentors for the transferability of technical skills.
 - Strategies partnerships for improved market opportunities.
 - Introduce mentorship programmes where formally trained metal fabricators provide on-the-job training for informal metal fabricators

(4) Technology and Infrastructure

- Establish community-based innovation centres that are well-equipped with green technologies for cost-effective product manufacturing.
- Incentivise innovations and inventions of green technologies for use by informal metal fabricators for processes like recycling.

(5) Funding and Support

- Government support in the form of grants, tax incentives and importation rebates to encourage informal metal fabricators to adopt or upgrade to new sustainable and energy-efficient production and waste management technology.

Notes

1. Vocational Education and Training emphasises the acquisition of technical skills and knowledge to foster behavioural competence in the workplace. The system may encompass where vocational skills are developed (training institution) and the degree of employer involvement (workplace)
2. The informal economy consists of workers, activities and enterprises that are not (weakly) monitored, regulated or registered by government and by extension, have limited or no access to public support in terms of access to capital, technology and skills.
3. Education 5.0 is highly innovative method, which can develop the teaching staff, students, administration to the next level of technology adoption in learning environment
4. The informal economy comprises mostly of workers, activities and enterprises that are not (weakly) monitored, regulated or registered by government and by extension, have limited or no access to public support in terms of access to capital, technology and skills.

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