Apprenticeship Plumber Training Initiatives for the Venerable Youth and Women: Public-Private-Partnership for Socio-Economic Development in Sub-Saharan Africa

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Abstract

Competent plumbers first priority had been provision of quality drinking water, sanitation, hygiene, risk assessment and risk management in community industrial systems for socio-economic development. Despite the critical role played by plumbers, youth and women capacity had been extremely low with unsatisfied customers. Apprenticeship training, with emphasis on financial literacy; and soft-skills were thought to improve their competence; enhance their intellectual capital, spiritual well-ness, mental and emotional-wellness for socio-economic empowerment. The purpose of the study was to establish what apprenticeship training initiatives could address global shortage of competent plumbers in Sub-Saharan Africa. The research design was based on randomised-multi-year-cross-sectional-survey. Primary and Secondary data was analysed to respond to the study objectives. The study found out that apprenticeship training, blended training with ICT component had potential for preparation of master plumber for all times. The study recommended apprenticeship training in a blended system with on-line component for the venerable youth and women for socio-economic development in Sub-Saharan Africa. Further systematic studies could be carried out to find out more on the potential of the Public-Private Partnership in apprenticeship training of plumbers at a global scale.

Key Words: **Youth and women, competent plumber, smart solutions, apprentices training, risk management, quality drinking water, sanitation, and hygiene**

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Background to the Study

Meeting the training needs in plumbing of the 21st Century calls for use of a set of training strategies and settings such career training, taking an institutional-based training cum industry sponsorship to attend apprenticeship in the industry, transfer of the classes from industry to vocational and technical institution of training and vice-versa; and community-based training (Sutton, 2021). A combination of the above strategies was likely to produce a balanced plumber ability to initiate smart solutions to problems, adapt the existing industrial systems to meet the modern challenges of climate change and providing ad-hoc solutions to provision of adequate clean and safe drinking water in an environment of water scarce global village (Holtz and Golubski, 2021). Besides, World Resources Institute (WRI) in Holtz and Golubski (2021), identified the challenges facing the smart design solutions is ability to secure revenue for investment in safe drinking water, sanitation and hygiene. One of the most trusted plumbing trade and reliable plumber training partner include the World Plumbing Council (WPC). World Plumbing Council is an initiative which works hand-in-hand with member associations, states, organizations and individual

plumbers to promote the best possible plumbing services through growth and development for high-class plumbing industries (WPC, 2022).

Hands-on exposure in the industry when blended with institution-based alone had higher competence and skills development chances than institution-based alone (Chung and Lin, 2018). One could learn from their mistakes, gains insight when rebuked or admonished by mentors who provided guided experiences. Trial-and-error was thought to act as experiment-analysis platform for improved productive work. The apprenticeship trainee benefited from online learning and training experiences from experienced trainers in TVET setting; gets opportunities to try out what they had learnt as training and learning improved their competence and skills in a blended training environment (Bazhenov and Luchaninov, 2014; and Maeko and Makgato, 2017).

Holtz and Golubski (2021) observed that the Sub-Saharan Africa investment needed for safe drinking water, sanitation and hygiene was about $35 billion per annum. Despite the need for such a heavy investment, WRI identified the challenges facing the smart design solutions was lack of ability to secure revenue for investment in safe drinking water, sanitation and hygiene, efficient plumbing systems, risks assessment and risk management in standard water quality desired in the 21st century communities (Holtz and Golubski, 2021; Mattucci and Johnson, 2003). Climate change, population explosion, water and energy scarcity and environmental concerns on bio-diversity provides an opportunity for genuine partnerships, collaboration between the communities, the government and the scientific communities (PACN, 2010; Holtz and Golubski, 2021; and WPC, 2022).

Statement of the Problem

The problem of plumbing systems failure seemed to be a synergetic result of resources management failure to conduct risks assessment and risk management in: presence of pathogens, harmful chemicals, decaying organic matter in the clean drinking-water systems; failures in the plumbing and piping systems leading to undesired mixing of sewage with clean drinking-water in the surface and underground water sources; among other challenges which affected the quality of commercial property, residential facilities, industrial systems leading to diverse forms of damage and loss.

Purpose of the Study and Specific Objectives of the Study

The study attempted to establish what the apprenticeship training initiatives have been implemented to address the global shortage of licenced, competent and highly qualified plumbers; with a specific focus on the situation in Sub-Saharan Africa. The specific objectives were: to determine what apprenticeship training initiatives were; to identify gaps in the Public-Private Partnership; to identify what was the jua-kali training potential among the venerable youth and women; and to enumerate what training strategies had potential in plumbers' development in the global market; and for socio-economic development in Sub-Saharan Africa

Methodology and Resources

The research design was based on randomised-multi-year-cross-sectional-survey (based on primary data from survey and archival retrieval of secondary data). The design used primary data collected in three phases based on time (year of survey) as a factor-

August 2014 (base year); August 2017- Sept 2018 (mid-term) and June-July 2022 (third-term and year of data analysis and reporting). Care was taken to ensure completeness of data collection and use of electronic storage devices for consistency and ease of analysis. Enumerators were trained and well distributed within the survey blocks.

The following coded blocks provided the randomly picked geographical areas to provide the primary data. Block A: (Wet Farming Areas). Jua Kali Center- Urban Centres; Block B: (Arab Artisans, Peri-Urban Areas Practicing some form of Irrigation for Agribusiness and Small-Holder Farms in Agricultural Areas, and their related Market; Arid areas with Seasonal Flood Water); Block C: (General Jua- Kali Enterprises); Block D: (Small-Scale Welders Associations); Block E: (Jua Limewaka (very hot weather conditions without working sheds)- Jua- Kali Artisans-Outskirts of Major Cities and Metropolitan Areas); Block F: (Jua- Kali Center-Sand harvesting areas); Block G: Jua- Kali centre (Good-luck Jua-Kali Association-cross-cultural-multi-ethnic-multi-lingual Towns); Block H: (Welding Traders (Arid and Semi-Arid Areas, Expert Enterprises and Jua Kali Enterprises in Tourist Destinations and Salt Harvesting); Block I: Jikaze na Witeithie (Work hard and Economic Stimulus Slogan-Furniture Enterprises Associations, County and Environs-Range-land); Block J: (Plumbers Master Training Experts Associations); and Block K: (Hospital Systems Maintenance Enterprises); Block L (Building Constructions, Major Road and Infrastructure Development). Secondary data was also used to fill in the gaps identified as well as provide a basis of comparison.

Policy Analysis and Review of Related Literature

The blended training initiative provides opportunities for creative innovations as problem-solving on day-to-day basis provides opportunity for career growth and development. The apprenticeship assessment if carried out in the target industry yields competence and skills-related data which would in turn be used to improve the apprenticeship initiatives approaches and strategies (Bazhenov and Luchaninov, 2014). Over the years, it has been documented that qualifications acquired in the blended scenario where an apprentice who is also attending institution-based training is enriched through participation of experienced mentors and master trainers who provide the necessary exposure to the entrepreneurial approach to acquisition of professional practice, competence and skills; as well as providing opportunities for creative innovations (Bazhenov and Luchaninov, 2014; Chung and Lin, 2018; Mattucci and Johnson, 2003; Palfrey, 2021).

The community interest and participation in Melbourne, Australia plumbing works through preservation of water-ways and domestic water-pipes benefited in terms of reduction of enormous saving of water and energy in various systems. The plumbing initiative was started in 2002; had representation from every state; and was based on the concept started by the National Plumbing Regulators Forum (NPRF) which benefited from community-based training of plumbers and domestic plumbing strategies (Halliday-Wynes and Stanwick, 2011). Specifically, the Government of Australia (2007), Department for Environment and Water Resources (DEWR) aimed at water conservation (reduce unnecessary wastage of water); provide information on purchase of water and use of water-saving products; and promote adoption of efficient and effective water-saving technologies. Conformity Assessment Bodies (CAB) monitored by the Standard Australia (GoA (2007, p.5). Although variation, modernisation and alteration might have been implemented under the Australian Government (AG October 10th, 2021), Department of Climate Change, Energy and; Environment and Water (DCCEEW) and other Australian authorities; the basic and

foundational legal framework, regulations and procedures governing plumbing might have remained unaltered (AG, 2021).

Results and Discussions

Study questions were discussed to respond to the study objectives as shown below.

What were the Products Made / Sold/ services offered in the Jua-Kali Enterprises?
What Jua-Kali aspects could be beneficial to the plumber apprenticeship training?

The products sold were mainly classified as:

a. *Services offered by the jua-kali industry include the following:* Mechanical engineering-reconstruction of car bodies, rim replacement, Break repairs, control of oil leaks and petrol, tyre puncture repairs

Car-washing, hotel services, shops, bus station construction, Dress-making and tailoring-making of new clothes and carry out repairs, barber shops (or Kinyozi) and salons, welding, repair of broken items, maintenance, making of new items, provide interns to students from nearby local technical institutions, painting, make lorries body parts, repair car bodies. The *jua-kali industry* partnering businesses included the following (small-scale in natures), Local Councils- toilets, water points, garbage collecting points, M-Pesa, hardware shops-provide material for jua kali constructions and engineering, spare-part shops spare parts for different machines, equipment and vehicles, shops for second-hand or repaired merchandise-toilets equipment, gas-cookers, stoves and bicycles, recycling scrap metals, transport of finished goods or purchases. The results suggested that some of the observed trade practiced were plumbing or plumbing related including the following. car-washing, hotel services, bus station construction, the *jua-kali industry* partnering businesses include the following (small-scale in natures), Local Councils- toilets, water points, Garbage collecting points, M-Pesa, hardware shops-provide material for jua kali constructions and engineering, spare-part shops spare parts for different machines, shops for second-hand or repaired merchandise-toilets equipment. All the above jua kali services and product related to workshops and working premises could provide a suitable environment for hands-on training of plumbers' apprentices to gain insight into the work-environment requiring endurance and perseverance in handling crisis and management of work-related stress.

b. *Agricultural Inputs or Agricultural Tools domains.* The Agricultural Inputs or Agricultural Tools domains included: Chaff-cutter and associated services; including setting-up and maintenance. Other included:

The study found that they were: pangas 8 (8.9%), fork jembes (hoes) 16 (17.4%), wheelbarrows-12 (13.0%), axes-16 (17.4%); and other Agricultural Appliances such as: milking cans 8 (8.9%), water buckets-8 (8.9%), coal-powered water heaters 8 (8.9%), gardening spades 8 (8.9%), and watering & feeding troughs 8 (8.9%). The results suggests that metallic water bucket was a critical tool for fetching water from the river or from a borehole, or from a spring or a well in the rural areas. The results also suggests that metallic water tank and the metallic water bucket were critical tool for fetching, storing and providing clean drinking rain water or from surface or from underground source for most of the rural areas where piped water was a scarce commodity or non-existent. Comparing the above results and the quality of water services in Africa had been marred by serious clean water supply imbalance indicated by 90% of the rich quartile in urban areas have over

60% treated-piped water on their premises while in some part of the rural areas, piped water was non-existent with the poorest half of the population using a certain form of improved water (UNDESA, 2014).

c. *Building construction supplies and related materials products were mainly related to the following:* Mattock 2 (4.4%), spades 4 (8.8%), Gutters 3 (6.7%), Door hinges-6 (13.2%), window stays 2 (4.4%), steel doors 5 (11.1%), windows 6 (13.2%), gates 5 (11.1%), metal grilling of all types 12 (26.7%).

The results suggests that majority of the observed trade practiced were not plumbing or plumbing related except: Gutters at 3 (6.7%). Gutters made from fabricated iron-sheets play an important role in rain water harvesting-systems which provide an alternative source of clean drinking water. In some cases, taking boiled rain water reduces chances of spreading common cold and other air-borne illnesses.

d. *The tools and equipment used by jua kali metal fabrication artisans include the following:* machines, equipment and facilities used, Marking gauge, Sliding level, Spring divider, Mallet, Nail punch, Pressure pumps, Working benches, Dies,

Protective wears gloves, goggles and overall- need for hard soled shoes or army boots, G-Clamps used in metal work, Spanners, Metal cutters, Blower which directs air into the fire to burn intensely to heat the scrap metals into red-hot condition for easier hammering, Anvils, Iron hammer. The simple tools include the following: Simple tools, Pliers, tongs, and magnets, Sawing machines, Metal working lathe machines, Hammer, Sledges hammer, Holding equipment e.g., a clap, wood working lathe machine, Welding machines, Constant power supply for lighting and arc welding, Electrical powered punch machine, Hand grinder, Hacksaws, Tape measure, Vice and drilling machines, Metal shears, Pick-up for transporting ready-made appliances to the market. Some of the financial literacy training and practice in jua kali include the following: Sharing of income, Equal terms-partnership/cooperative ownership. Lmited apprenticeship-oriented master trainers in Kenya might need a smart solution.

What training incentives were offered by trainers to encourage attendance to the formal training?

One (1) out of five (5) (20%) master trainers provide two (2) days off in a week to provide an opportunity for formal training and attend to assignment given. One (1) out of five (5) provide opportunities for workshops and conferences for exchange of experiences, self-improvement and build ones socio-network for future growth and development. One (1) out of five (5) (20%) master trainers make it a requirement for one have started some form of formal training if continued working relationship is expected. Three (3) out of five (5) (60%) of the apprenticeship with the support from master trainer were involved in on-line based personal research to learn on the job, solve problems, exchange ideas with peers and get socio-network for collaborative learning. Majority (over 80%) of the jua-kali artisans would prefer full-time apprenticeship attendance to optimise on the labour for training exchange. The apprenticeship trainee benefits from online learning and training experiences from experienced trainers in TVET setting; gets opportunities to try out what they have learnt as training and learning improve competence and skills through a blended training initiative (Bazhenov and Luchaninov, 2014; and Maeko and Makgato, 2017).

How many apprentices were involved in the jua-kali artisan apprenticeship training program? What was the apprentices' level of education?

What was the duration of their basic training?

Number of jua-kali apprentices in registered trade association was 38 (27.9%). The number of the other specific trade apprentices was: Woodwork 4 (2.9%), Wood-work 2 (1.5%), take one year; Tailoring 20 (14.7%), Hair-cutting 8 (5.9%), Hair dressing 21 (15.4%), Mechanics 15 (11.0%), Phone and electronic repair 17 (12.5%), Majority standard primary school leavers, Minority secondary school leavers, Welding 6 (4.4%), 3-6 months, Hairdressing 6 (4.4%), months, 5-8 months. The shorter the time take, the less the skills needed for the apprentice to start his or her own business. Trainers provide them with practical and theoretical training Learn the art and later master the art in their areas of specialization. Duration of training 2-7 months, 2-4 months, 4-7 months, 6-8 months, 4-7 months, 6-9 months, or 2 years. Automotive mechanics have more apprentices than other sectors. Apprentices were employed by their trainers. Majority of apprentices were primary and secondary school graduates. One possible reason behind the short time (2-4, 3-6, 4-7 months, 6-8, 5-8 months or 1 or 2 year) of apprenticeship training might have been affordability since that apprenticeship training was not easily accessible for the poor and the venerable people groups (poor youth and women, disadvantaged people groups) due to financial and materials constraints (World Bank, 2013). Length of training period depends on ones areas of specialization. Another reason, some trainees quit after a little while complaining of inability to pursue their dreams, harsh working conditions, doing tedious manual work. Factor affecting duration: apprentices' dedication, keenness and interest on the job. The master trainers' analysis was that the higher the level of education and qualification grades, the higher the probability of endurance for number of years. The intervention measures might include: provide compulsory secondary education (with at least 90% transition), providing financial support pegged on apprenticeship training duration (say two years and above), helping the apprentice find a training HELB loans, provide incentives because a plumber who has consistently served the same customers for the last ten (10) years, the person qualifies as a master trainer or mentor (GoK, 2022, Zippia, 2022). In some cases, it takes as long as 29 years on the tools, before qualifying as master trainer and mentor for several years (Builders Academy in Australia, 2016).

What were the gender representation in plumbing as a trade? What reasons were associated with the gender representation?

Eight (8) out of a sample of 265 (3.02%) of the plumbers contacted, were female. The results could have needed further scrutiny and interrogation to further find out whether that was the actual positon in regard to gender imbalance in plumbing in other studies. Zippia (2022) observed that in the US, 3.5% of the plumbers were female while 96.5% of the plumbers were male. Similarly, in South Africa, gender representation results in a sample working with 1074 plumber respondents, more male than female at 97% and 3% were observed (IOPSA, 2021). Similarly, Law and Mark (2009) indicated that women students were likely to take up training as teachers and nurses rather than as engineers or plumbers. Similarly, ILO (2019) and IOPSA (2021) found that among the skilled and competent workers, plumbing was predominantly male. For example, in South Africa, women formed 5.4% of the plumbers and their apprentices in population (Statistics in SA, IOPSA, 2021). Similarly,

Degen and Tonhauser (2021) observed that more men were likely to work as plumbers compared to women.

What was the reason for the specific gender representation?
Are gender stereotypes and discrimination still persistent in the modern society?
One female plumber in one of the Eastern and Central African state was quoted saying that as a master plumbing trainer, she found herself relocated from her vocational and technical training institution to go to another ordinary high school to teach chemistry and physics against her wish. That case represented experiences of gender stereotypes and discrimination which were present in the society. One of the reason cited as the reason were: gender stereotypes (plumbing is only seen being done by men), male vector in the plumbing career in the advertisements of being a masculine and physically built business owner, fitter, services representative and mentor or master trainer (being a male) (WorldSkills, 2017, 2020). ILO (2019) observed that there was need for gender mainstreaming in skills development. One of the initiatives in gender mainstreaming in employment opportunities suggested was the need to attempt to provide avenues and strategies which enhanced attitude change towards certain trades for female trainers.

What was the trainer: apprentice ratio?
What is the mode of payment for apprenticeship training?
What interventions have been introduced?
Although the ratio of trainer to trainees is 1:1, the training depends on the actual facilities and equipment available at the canter. Apprenticeship embraced. Mode of payment: some pay on agreed amount as well as labour provided; others pay by their labour provided. In 1980s, the then ministry of technical training and applied technology encouraged the formation of worksite associations (GoK, 2020 and ILO, 2019). Later in 1992, Kenya national federation of jua-kali association was initiated to develop advocacy, lobbying, coordination and networking with conserved ministry or interested stakeholders (GoK, 2020). Despite the efforts, apprentices does not have certificate after taking training or after taking the grade test, the grade test certificates may not be accessible.
The following questions were related to the mentors and their apprentices. Primary data provided the challenges while a combination of secondary and primary data provided solutions
What were challenges facing the apprenticeship training?
What are the possible solutions?

Challenges: Possible and Recommended Solutions
Expensive tools and equipment: Provide tools and equipment in a common pool near jua kali sheds for lending at a fee.
Illicit brews drinking due to frustrations: Provide rehabilitation of affected personnel
Unplanned construction lead to blocked sewers: Engineers can provide proper planning to accommodate jua kali as important economic drivers
Expensive Licenses: Provide charges commensurate to one's income
Enterprise owners unable to secure their shops and land: Center for International Private Enterprise (CIPE) associations
Lack of dialogue between government and jua kali: Provide advocacy and other legal processes for jua kali sector
Inadequate working space causing congestion: Uwezo Fund to be used for purchasing land for jua kali

Local council or county governments to provide jua kali working spaces in accessible areas
Entrepreneurs and workers are disorganized due to lack of guided experiences: Need for the incentives for part-time formal vocational and technical training of trainers
Safety: Accidents with trainees-minor injuries; Bright flames affect eye-sight; Poor working conditions, sometimes venerable to poor health conditions: Put on protective wears-industrial gloves, overall, leather boots, use of light shields to protect clothes damaging light, Provide health insurance e.g., NHIF
Theft of equipment, facilities and products: Comprehensive insurance policy Security guards
Shortage of raw materials-3; Raw materials are expensive-3: Source for raw-materials from other countries
Manual work unpopular with majority of Kenyan youth: provide commensurate or higher pay for manual jobs in the development projects
Apprentices attend training at in irregular intervals: Provide incentives for regular long-term training
Intense heat is considered a health hazard

Source: GoK, Uwezo Fund (2020), GoK, KNA (2022), ILO (2019), ARI (2016), ILO (2012) and IOPSA (2021)

The study 2014-2022 finding in Table 1 in indicated that the major obstacles to business development among the initiatives in the jua-kali sector include inadequate loan facilities, lack of market for their products, inability of would-be buyers to purchase as well as lack of business skills. Similarly, CIPE (2018) found that challenges affecting the informal sector in Mathare Informal Settlements included: lack of business skills, training, mentors and apprenticeship opportunities. Again, Uwezo Fund is a Government of Kenya flagship programme which aimed at meeting the need for soft loans targeting the needy youth, women and people living with disabilities to finance their business initiatives disbursed at the constituency level (GoK, UF, 2020). Again, Uwezo Fund had made strides in providing training of youth and women in various instituions (GoK, KNA, 2022). Similarly, Center for **I**nternational **P**rivate **E**nterprise (CIPE, 2020) recommended that the Jua-kali working areas should be secured by acquiring title-deeds as a way of supporting youth and women enterprises. Jua-Kali artisans and technicians could have 17% chances of finding employment in the construction sector (Cheruyot, 2021). The Uwezo Fund initiatives might need further material and logistical support from door countries in terms to facilitate support a specific focus of plumber among the youth and women apprenticeship training and development. Women plumbers who have hands-on experience from work-based training were able to secure employment (GoK, TVETA, 2020). These findings suggests a need to appraise the apprenticeship training and training of mentors for appraisal of plumbers for clean drinking water for healthy living and sustainable development in Sub-Sharan Africa. The following questions were related to the mentors and their apprentices. Secondary Data was used.

What is your age?
What are your age-related-responsibilities and duties?

Globally, plumbers' age trend shows apprenticeship was open for 16-18 year-old, but rarely taken until after 24-25 years of age; with a majority of workers at 42 years; with the median age at 33 years; and 53% are in the age above 45 years and in some countries at 54-58 years one is considered as a master trainer and a mentor in plumbing. In the US, plumber age range between 35 and 50 years of age; and an average age of 42 years (Zippia, 2022). In South Africa, age composition of plumbing respondents includes: 20-29 year-old formed a minority at 9%; 30-50 year-old formed the majority at 66%, while those older than 50-year-old formed about 25% (IOPSA, 2021). ILO (2019) noted the presence of child labour. The

organization advised the unions to ensure that child labour is completely eliminated except for those undergoing apprenticeship-ensuring that the work they do is less hazardous. The participation of plumbers in union activities has higher chances of creating awareness on the spread of COVID-19 and HIV/AIDS, practice of high levels of cleanliness and hygiene.

The following questions were related to the mentors and their apprentices. Secondary Data was used.

What is the importance of mentorship?

How does one become a master builder, contractor or plumber?

A plumber who has consistently served the same customers for the last ten (10) years, the person qualifies as a master trainer or mentor (Zippia, 2022). Another has taken 29 years on the tools, later works as a trainer and mentor for over number of years for example Vinnie, Plumber Trainer working with (Builders Academy in Australia, 2016). Mentors or master trainers are beneficial to the apprentice (new employee), to the company in terms of the: social-capital, intellectual and material capital (accumulated over 10 or more years) associated with the contribution of a mentor) and other mentors in terms of comparing notes within the organization, across the business association, in a cooperative movement, and a group of cohesive-groups-of informal enterprise (Builders Academy in Australia, 2016; and WorldSkills, 2019).

The following questions were related to the mentors and their apprentices. Secondary Data was used.

What is your level of: experience/ qualification/ licencing?

Apart from work experience, there is another important factor in skilled workforce among the plumbers: need for licencing. IOPSA (2021) observed a unique mix of respondents including licenced respondent builders being 81% while the qualified plumbers' respondent only made about 13%. The above results suggest that in the 2020 statistics, the level of licencing and qualification among the plumbers was generally very low. In mixed race nations like in South Africa, the proportion of licenced white plumbers was 63% compared to other races; again having the bulk of white qualified plumbers compared to other races (IOPSA, 2021). The possible explanation of that scenario has a lot to do with family values, traditions and line of trade. A son of a master plumber or one born when a close relative is a master plumber has higher chance of become qualified, licenced or being a master trainer also (Builders Academy in Australia, 2016).

The following questions were related to employment opportunities and apprenticeship training. Secondary Data was used.

Who do you work for?

The bulk of the respondents (67%) were self-employed plumbers and their apprentices, another small group (22%) worked with plumbing companies; while another rare minority (5%) and (3%) were hired by a construction company and the government respectively. The results suggests that a public-private partnership might play an important role in that the informal sector could a greater role in apprenticeship training both for the college graduates and the fresh apprenticeship from high school. The mentorship initiatives and business

associations might need to identify which organizations, actors, community-based initiatives and formal training providers might be willing to participate in the apprenticeship programs.

The following questions were related to the mentors and their apprentices. Primary Data was used.

What are some of the strategies plumbers use to overcome problem of lack of a workshop or working shed?

Workshops, Sites and recognized venues where juali-kali plumbing artisans could be found include: pipes and fittings supply store; building and road construction sites; water supply and sewage treatment institutions; internship centres for the plumbers in the county government establishments, local villages shops among other.

What are some of the plumbing products and services make customers unhappy?

The customer level of satisfaction with the plumbing products and services was rated very low, i.e., 1 or 2 in a 10 (where 1 or 2 shows extremely poor services while 10 shows the best maser-piece work by highly and competent workers. *To respond to the question of what products or services were most dissatisfying for specific customers, secondary Data (Source:* Bartingale Mechanical, 2020) *was used. Faulty plumbing work results in problems associated with plumbing which include the following*. One, dripping faucets; for example water taps, cocks, or small opening on the waste-water pipes joints or clean water pipes causing leakages. These features when they having constant dripping or leakages are considered to be costly, wasteful and annoying to customers. Two, leaking pipes (can be cause by all kindly of challenges including: broken seals, clogged lines, corrosion, incorrect pipe laying, damaged joints, underground movements, high water pressure and introducing tree roots near the system. Three, running toilets: Dale and Epstein (2021) observed that running toilet has been associated with the problem of flush valve assembly. Four, low water pressure; clogged pipes develop blockage which might reduce the water pressure. Five, water heater problems; which might be associated with faulty temperature and pressure relief valve, improper water pressure, overheating, as tuck valve, a leakage from the nearby plumbing connections, loose heating element bolts, a bad gasket, and a leaking water tank (Dale and Epstein, 2021; and Bartingale Mechanical, 2020).

Rotational system of apprenticeship training initiative (RSATI) works in situation where the master craft-man harness his capabilities within the network of trusted business associations, business community, and other stakeholders in providing a variety of competence and skills not available in his workshop (ILO, 2012). Plumbing, in particular calls for the adjustment to work in a RSATI since the trade requires a multi-disciplinary approach in training in different specializations, skills and competences-say: craftsmanship, architecture, technical drawing, wood work an joinery, masonry, metal-work fabrications, brick-laying, plastic craftsmanship, road construction, kitchen ware installation, drainage systems maintenance, clean water risk assessment and risk management among other (ILO, 2012, p.9). Fig 1 shows the Rotational system of apprenticeship training initiative (RSATI).

To decide on which business enterprise or trade or workshop is to participate in the rotational apprenticeship training initiative and business community sharing of knowledge and experiences, the following criteria might need careful consideration as adopted from the

What is the role of Industrial- TVET- blended- training in Apprenticeship Training?

Industrial Mechatronics Technician training initiative which was an initiative of the Kenyan Government supported by the German Government has a blended system of TVET training for the youth and women in Kenya (KTN, 2022). However, the areas of training in the above initiative did not yet have the programme which could support plumbers training. Therefore, it might be imperative that apprenticeship training of plumbers which takes the Industrial- TVET- blended- training approach be considered for support and financing.

Conclusion and Recommendations

The study found that from the year 2020 onward, there had been efforts towards achieving sustainable development through competence-based training and education through work-based blended with TVET formal training. However, the need for mentorship and apprenticeship training for provision of clean drinking water, a stimulus package for the development of competent plumbers' master trainers for the 21st century for socio-economic development in Sub-Saharan Africa might require a systematic study. Therefore, apprenticeship training initiatives for plumbers in Sub-Saharan Africa is urgent and necessary.

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Appendix 1: Rotational system of apprenticeship training initiative (RSATI)

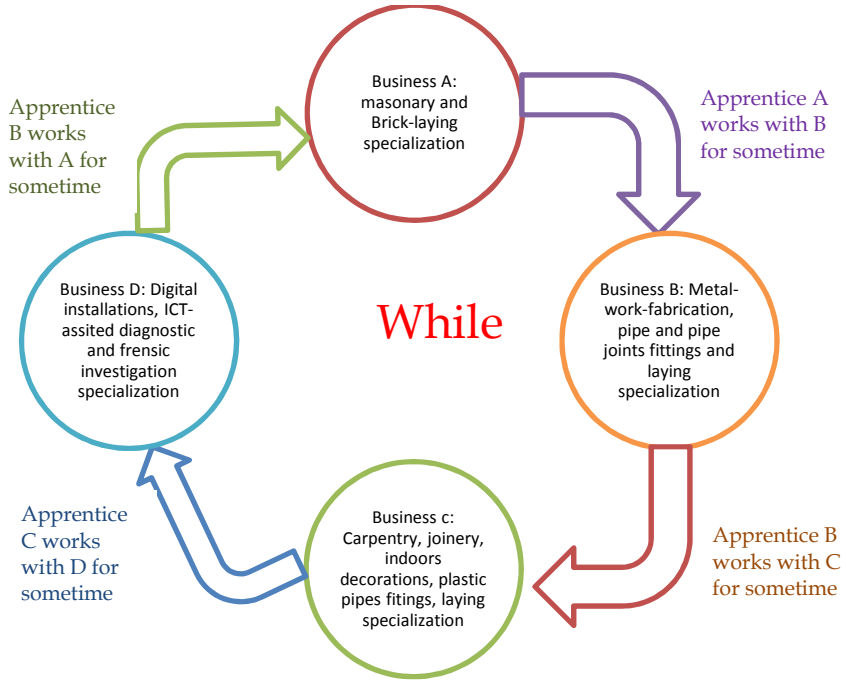

Fig 1: Rotational system of apprenticeship training initiative (RSATI)
Source: Adapted from Fig 1 in ILO (2012, p.45)