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ABSTRACT

Technical and vocational education and training (TVET) has emerged as an avenue through which Kenya aims to fast track her ambition for upper-middle-income economy status, together with the realization of the Big 4 Agenda. However, like other sectors, the TVET sector has shown its vulnerability to sudden and disruptive events manifested by the inability to conduct online training in the wake of the novel Covid-19 pandemic. Such vulnerability has necessitated the need for TVETs to embrace change in training to build resilience in TVET institutions. The Leagile framework has proven to be a stochastic dynamic decision-making tool to handle excursion events in the modern supply chain occasioned by uncertain and turbulent markets. The article adopts a self-completion survey via SMS that targets TVET trainers drawn from TVET institutions in Uasin Gishu County, Kenya. Data is collected using a structured questionnaire administered via SMS. The multiple regressions analysis results confirm that Leagile pedagogy positively and significantly influences resilience building.

KEYWORDS
Agile Pedagogy, Leagile Pedagogy, Lean Pedagogy, Resilience, Uncertainties

INTRODUCTION

The eruption of the coronavirus, known far and wide as COVID-19, unleashed a global catastrophe with far-reaching consequences. The World Health Organization (WHO) declared it a worldwide pandemic on March 11, 2020 (The New York Times, 2020). As people around the globe grappled with the profound human suffering and economic upheaval caused by the pandemic, it became evident that certain sectors faced unprecedented challenges.

One such sector that found itself navigating tumultuous waters was education. According to UNESCO (2020), the closure of educational institutions across the globe, necessitated by nationwide lockdowns and localized shutdowns, disrupted the education of nearly 1.8 billion students. In
Kenya, where approximately 17 million learners were affected by the government’s decision to close educational institutions on March 15, 2020, a cascade of economic and social issues ensued (Jelimo, 2020). This educational disruption was further exacerbated by the swift introduction of digital and remote learning solutions, a measure taken to mitigate the impact of the closures (Ngwacho, 2020). However, this transition to digital learning left many learners marginalized due to limited access to electricity and the Internet, intensifying the challenges faced by the education system (Jelimo, 2020).

In this maelstrom of educational turmoil, one particular facet, the Technical and Vocational Education and Training (TVET) sector, confronted a unique set of challenges. TVET institutions, including Polytechnics, Technical Training Institutes (TTIs), Vocational Training Centers (VCTs), and other technical skills learning institutions, play a pivotal role in nurturing a skilled workforce and providing career advancement opportunities for school leavers. These institutions have a rich history in Kenya, dating back to 1924 with the establishment of the Native Industrial Training Depot (NITD) in Kabete, Nairobi, followed by the founding of Kaiboi and Mawego trade schools by Catholic Missionaries. Over the years, these institutions evolved into Technical Training Institutions (TTIs) after independence, with the introduction of the 8-4-4 education system in 1985 (Simiyu et al., 2021).

However, as the demand for skilled personnel grew, the TVET sector experienced uncontrolled expansion, leading to compromised training standards and a mismatch between training outputs and industry needs. Consequently, reforms were initiated in the education sector, as mandated by the 2010 Constitution, culminating in the Sessional Paper No. 14 of 2012. This policy framework restructured education and training into three sub-sectors: basic education, tertiary education, and university education. The TVET Authority was established through an Act of Parliament to regulate the TVET sub-sector (Maina et al., 2017). Today, with the implementation of the Competency-Based Education and Training (CBET) curriculum, which emphasizes practical experience and technical skills, the TVET sector stands at a critical juncture in its evolution.

The onset of the pandemic intensified these challenges. In Kenya, approximately 17 million learners were impacted by the government’s decision to close schools on March 15, 2020, to curb the spread of the virus (Jelimo, 2020). The rapid introduction of digital and remote learning solutions as a response to the closures (Ngwacho, 2020) left many learners marginalized due to limited access to electricity and the Internet (Jelimo, 2020).

In this tumultuous context, the TVET sector grappled with the practical, hands-on nature of its courses, which made the shift to online learning particularly challenging (Oduor, 2021). Despite Kenya’s commitment to achieving Vision 2030 and realizing the priority initiatives of the Big 4 Agenda, which include food security and nutrition, universal healthcare, affordable housing, and manufacturing—with TVET playing a pivotal role (Kenya News Agency, 2018)—the pandemic exposed vulnerabilities in the sector’s ability to adapt swiftly.

Moreover, as a United Nations member, Kenya aligns with sustainable development goal number 4, advocating for inclusive and equitable quality education (UN, 2015b). The need for resilience in the TVET sector in Kenya has become increasingly evident. Embracing change and fundamentally shifting TVET pedagogy to navigate these types of challenges is now not only an aspiration but an imperative for the sector’s survival and growth in a post-pandemic world.

LITERATURE REVIEW

The Concept of Resilience in TVETs

Resilience, rooted in the Latin word “resilio”, meaning to rebound or spring back, is a concept that has gained prominence in organizations, drawing insights from contingency and coping theories (Gittelli, 2008). Several definitions of organizational resilience have emerged from these foundations. It is often described as the ability to maintain positive realignment despite challenging conditions (Vogue & Sutcliffe, 2007) or as the capacity of an enterprise to survive, adapt, and grow in turbulent
environments (Fiksel, 2006). Lengruck-Hall et al. (2011) define it as the capability to absorb effectively, respond to specific circumstances, and engage in transformative activities to address disruptive shocks.

In a supply chain context, resilience has gained significance, particularly in an increasingly competitive business environment (Ponis & Spanos, 2009). Supply chain resilience is the adaptive capability that enables the supply chain to maintain continuity by recovering from unexpected disruptive events (Ponomaror & Holcomb, 2009). It is also the potential of the supply chain to handle adverse effects stemming from disturbances (Barroso et al., 2012).

This paper views TVET institutions as constituting a supply chain focused on the core activities required to transform students into TVET graduates. Like commercial organizations, TVETs must handle accountability and competitive pressures, and they have a need for effective logistics supply chain management (LSCM) processes. Thus, TVETs should demonstrate the adaptive capability necessary to maintain continuity and benefit the economy and society (UNESCO-UNEVOC, 2007).

Reviewing existing literature on supply chain resilience reveals several indicators. Collaboration, involving effective joint planning and task execution, anticipation of disruptions, and risk mitigation, is critical (Hsieh, 2018; Qian et al., 2018; Simatupang & Sridharan, 2008). Sustainability, encompassing policies that benefit society and the environment to ensure resource availability, is also emphasized (Hafezalkotob & Zamani, 2018; Jain et al., 2017). Redundancy, represented by backup or alternative suppliers and rapid switching following disruptions, is another crucial facet (Aghaei et al., 2017; Esmaeili et al., 2018). Flexibility, or the ability to adapt to disruptions without impacting the flow, is critical (Pettit et al., 2013). Visibility, which means tracking parts, products, or components in transit, plays a significant role (Azadeh et al., 2014). Information sharing and adaptability are also highlighted, relating to the availability of crucial information and the ability to adjust the supply chain’s design in response to shifts, disruptions, and changing customer behavior (Jain et al., 2017; Sestak et al., 2018; Tohidi et al., 2017).

Viewing these ideas in the context of TVET institutions (TVETs), resilience would rely on collaborative partnerships for risk management, prudent resource utilization, flexible course scheduling, visible structures, adaptive capacity, and a strong market position that fosters innovation. This paper measures TVET resilience with regard to collaboration, sustainability, redundancy, visibility, and adaptability.

The Concept of a Leagile Supply Chain

The leagile framework presents a dynamic paradigm that fuses the principles of lean and agile methodologies to ensure operational efficiency and responsiveness (Andrew, 2020). According to Banerjee and Ganjeizadeh (2017), leagile represents a supply chain strategy that harmoniously combines leanness and agility to meet market demands effectively. Sindre (2019) highlights that many higher education frameworks traditionally adhere to rigid, plan-based approaches and suggests that they stand to gain significantly from embracing lean and agile frameworks. Such an educational approach allows students to take charge of their learning journey through iterative decision-making. In the context of TVETs as supply chains, embracing a pedagogy rooted in lean and agile methodologies can revolutionize training.

Leagile pedagogy draws inspiration from logistics and supply chain management paradigms, encompassing agile education, agile classrooms, agile pedagogy, and lean education (Judd & Blair, 2019). Morien (2019) defines pedagogical agility as the capacity to adapt to market changes swiftly. By incorporating pedagogical agility, higher education institutions, including TVETs, can effectively respond to shifting market conditions, as exemplified by the challenges posed by events like the COVID-19 pandemic. In contrast, pedagogical leanness aims to streamline knowledge delivery by minimizing time, transportation, and motion waste, ensuring continuous and efficient learning (Morien, 2019).

This study posits that by adopting leagile pedagogy, TVETs can make timely decisions and cultivate behaviors that enhance efficiency, minimize waste, embrace change, and bolster resilience.
against sudden disruptive events. Consequently, this study’s independent variables include agile pedagogy, measured through knowledge sharing, collaboration, engagement, and creativity/innovation (Sanders-Blackman, 2019), and lean pedagogy, gauged by continuous improvement and respect for people and systems (Balizer, 2016). Additionally, the study conceptualizes building resilience in TVETs, measured through sustainability, redundancy, visibility, and adaptability; thus, resiliency is the dependent variable.

**Empirical Review of Literature: A Critical Analysis**

**Agile Pedagogy in Education**

Several studies have ventured into exploring agile methodologies in education. For instance, López-Alcarria et al. (2019) conducted a systematic review focusing on using agile methods to nurture sustainable competencies in education. They found that agile education can create a conducive learning environment, improve student motivation, satisfaction, and performance, and promote responsible and sustainable citizens. However, a notable limitation of their study is the absence of explicit insights into how agile education might enhance institutional resilience in the face of sudden disruptions.

In another systematic review, Parsons and MacCallum (2019) delved into the impact of importing industry-level methodologies into education. They concluded that agile methods in education led to knowledge generation rather than traditional knowledge transfer and emphasized collaborative learning, somewhat reducing the teacher’s role to that of a facilitator. While their findings underscore the importance of incorporating agile pedagogy in education, it remains unclear how knowledge generation and student empowerment directly correlate with institutional resilience in the face of unexpected disruptions.

In another study, Prejean et al. (2019) examined the adoption of agile management in higher education. They noted that agile education had been initiated to meet business and labor market demands but had only recently gained momentum in these institutions. Although this study opened avenues for further exploration of agile pedagogy, it lacked specific categorization of higher education institutions, which limits the depth of their findings.

Collectively, these empirical studies highlight some contextual and methodological gaps. Firstly, there is a lack of research on agile pedagogy in the TVET sector. Secondly, many of the reported studies rely on systematic reviews, which may not comprehensively address the potential impact of agile methodology on institutional resilience. Consequently, it is essential to critically consider these limitations when assessing the influence of agile pedagogy on the resilience of TVET institutions, particularly in mitigating the impacts of events like COVID-19.

**Lean Pedagogy in Education**

Empirical research on lean pedagogy in higher education has garnered considerable attention. Balzer, Francis, et al. (2016) reviewed lean practices in higher education and found that it significantly improved academic and administrative functions. However, they also noted that the successful implementation of lean practices required long-term and strategic planning. While their findings emphasize the benefits of lean pedagogy, they also underscore the challenges associated with its implementation.

In another study, Thomas et al. (2015) compared lean implementation in higher education institutions (HEIs) and further education institutions (FEIs) in the UK. Their study revealed that FEIs exhibited more experience developing and implementing lean initiatives but lacked the infrastructure and dynamism to drive lean pedagogy effectively. On the other hand, HEIs showed more enthusiasm and willingness to embrace lean initiatives, albeit at a slower pace. This study highlights the disparities in lean adoption across different types of institutions.

Additionally, Davidson et al. (2020) reviewed Lean Six Sigma and quality frameworks in higher education. They identified a lack of tools and techniques for continuous improvement within the
quality frameworks in use at institutions. They proposed that Lean Six Sigma could offer an effective approach to continuous improvement, provided certain factors like active leadership commitment, cross-organizational communication, and a culture of customer focus and improvement were in place.

It is crucial to note that most of these studies primarily focus on higher education, and the infrastructure and dynamics within TVET institutions in Kenya can vary significantly. Therefore, the applicability and viability of lean pedagogy in TVETs as a basis for building resilience should be scrutinized. The distinct context of TVET institutions in Kenya warrants a critical examination of whether lean pedagogy significantly influences their resilience in mitigating the impacts of crises like the COVID pandemic.

METHODOLOGY

This study focuses on TVET trainers in select institutions within Uasin Gishu County, comprising a total target population of 550 trainers. To determine the sample size, Krejcie and Morgan’s sample size table from 1970 guided the selection of 226 trainers. Proportionate stratified and simple random sampling techniques were employed to select the 226 trainers from their respective TVET institutions.

Due to COVID-19 health protocols, a self-completion survey via SMS was adopted. Mobile telephone numbers from departmental trainer nominal rolls were used to identify potential respondents. These individuals received a phone call inviting them to participate and complete a questionnaire sent via SMS. The questionnaire encompassed three scales representing the study’s three constructs:

1. For assessing lean readiness levels of TVET institutions, a customized five-level scale based on the SAUCE model (Start-Awareness-Unstructured-Continued-Evolved) initially proposed by Al-Ashaab et al. (2013) was employed.
2. To measure the agile potential of TVETs, the Sidky Agile Measurement Index (SAMI), a value-based agility roadmap by Sidky et al. (2007), was adapted.
3. To evaluate the building of resilience in TVETs, the Resilience at Work Team Scale, developed by McEwen and Boyd (2018), was used. This 9-item scale was chosen since resilience building in TVET often necessitates teamwork.

Data analysis was conducted using SPSS version 23. Descriptive results were presented as percentages, while inferential results were reported through multiple regression models.

RESULTS

Descriptive Results

Upon excluding trainers who declined participation or could not be reached, 152 eligible trainers participated in the study. The relevant demographics of these participating trainers are depicted in Table 1. Some significant details from these demographics are that there was a balanced gender distribution among the participants, with 57.9% males and 42.1% females. Most trainers (70.4%) fell within the age range of 34 to 49 years. Regarding educational qualifications, 52.6% held bachelor’s degrees, while 39.5% were technical college graduates. Notably, trainers exhibited significant teaching experience, with 46.1% having seven to 11 years of experience and 32.9% with 12 to 16 years. Most (92.1%) were trainers under the Public Service Commission.

Table 2 shows participants’ views on whether TVETS are adopting lean pedagogical practices. The descriptive analyses indicate that TVET institutions have significantly shifted pedagogical paradigms towards lean and agile practices employed in industrial supply chains. This shift aims to enhance resilience against sudden disruptions such as the COVID-19 pandemic. Notably, TVETs are adopting lean practices, including course design with a focus on beneficiaries and values, fostering a
culture of critical evaluation of training outcomes, waste elimination in training processes, encouraging trainees to assess outputs in terms of value, and embracing continuous improvement and adaptability.

Additionally, Table 3, which shows participants’ views on whether TVETS are adopting agile pedagogical practices, reveals that various agile practices have been integrated into TVET training. These practices encompass knowledge sharing, collaborative training, fostering creativity and innovativeness, flexibility in training, task engagement, transparency in training systems, nurturing healthy interactions between trainers and trainees, and establishing cross-linkages between TVET institutions.

<table>
<thead>
<tr>
<th>Lean Practices in TVETs After the COVID-19 Pandemic</th>
<th>Strongly Disagree %</th>
<th>Disagree %</th>
<th>Moderately Agree %</th>
<th>Agree %</th>
<th>Strongly Agree %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Courses are being designed with beneficiaries and values in mind</td>
<td>3.9%</td>
<td>15.8%</td>
<td>36.8%</td>
<td>30.3%</td>
<td>13.2%</td>
</tr>
<tr>
<td>2. Training is endeavoring to create a culture of critical and repetitive examination of training outcomes for value addition</td>
<td>2.0%</td>
<td>9.9%</td>
<td>15.1%</td>
<td>57.9%</td>
<td>15.1%</td>
</tr>
<tr>
<td>3. Trainers are emphasizing processes that eliminate waste in training and improve knowledge generation</td>
<td>1.3%</td>
<td>13.2%</td>
<td>17.1%</td>
<td>54.6%</td>
<td>13.8%</td>
</tr>
<tr>
<td>4. Trainees are being encouraged to evaluate output with beneficiary and value in mind</td>
<td>2.0%</td>
<td>9.9%</td>
<td>15.9%</td>
<td>54.3%</td>
<td>17.9%</td>
</tr>
<tr>
<td>5. Trainees are striving for perfection through continuous improvement and a willingness to change processes</td>
<td>2.6%</td>
<td>12.5%</td>
<td>17.8%</td>
<td>48.7%</td>
<td>18.4%</td>
</tr>
</tbody>
</table>
Building on this information, Table 4 demonstrates TVET institutions’ efforts to enhance resilience. These endeavors include becoming more strategic and visionary, promoting effective and open communication, prioritizing value-specific courses, adapting training tools to relevant sectors, listening to customer feedback, and strengthening their market visibility.

Inferential Results

The primary inferential technique employed in this study was multiple regression analysis. To construct the respective constructs, data from each scale were summed. Before conducting regressions, several
regression assumptions were tested. Normality tests were carried out to confirm the normal distribution of data for the three constructs, as presented in Table 5.

Linearity was confirmed between resilience building and both lean pedagogy (p-value for deviation from linearity > 0.05) and agile pedagogy (p-value for deviation from linearity > 0.05). Furthermore, there were no multicollinearity issues, with low Variance Inflation Factors (VIF) for both lean pedagogy (VIF=1.645) and agile pedagogy (VIF=1.314). The data for lean and agile pedagogy constructs exhibited homogeneity, as indicated by non-significant Levene statistics. Bivariate correlations in Table 6 supported the continuation of the multiple regression analysis.

Subsequently, as depicted in Table 7, the multiple regression analysis results for the model relating leagile pedagogy with resilience building in TVET were significant (F(2,148) = 1063.194, p<0.001), with an R² of 0.935. Both lean pedagogy (b = 1.202, t(148) = 5.785, p<0.001) and agile pedagogy (b = 0.411, t(148) = 4.989, p<0.001) were found to be positive and highly significant predictors of resilience building in TVET institutions.

### Table 5. Tests of normality

<table>
<thead>
<tr>
<th></th>
<th>Statistic</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean pedagogy</td>
<td>.063</td>
<td>151</td>
<td>.195</td>
</tr>
<tr>
<td>Agile pedagogy</td>
<td>.060</td>
<td>151</td>
<td>.200*</td>
</tr>
<tr>
<td>Resilience building</td>
<td>.065</td>
<td>151</td>
<td>.175</td>
</tr>
</tbody>
</table>

*Note. * = This is a lower bound of the true significance; *= Lilliefors Significance Correction.

### Table 6. Correlations

<table>
<thead>
<tr>
<th></th>
<th>Lean Pedagogy</th>
<th>Agile Pedagogy</th>
<th>Resilience Building</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean pedagogy</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agile pedagogy</td>
<td>.760**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Resilience building</td>
<td>.596**</td>
<td>.716**</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note. ** = Correlation is significant at the 0.01 level (2-tailed).

### Table 7. Direct effects summary and coefficients model summary

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.967*</td>
<td>.935</td>
<td>.934</td>
<td>4.35197</td>
</tr>
</tbody>
</table>

* Predictors: (Constant), Agile pedagogy, Lean pedagogy

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>(Constant)</td>
<td>-2.129</td>
<td>.802</td>
<td>-2.653</td>
</tr>
<tr>
<td>Lean pedagogy</td>
<td>1.202</td>
<td>.208</td>
<td>.523</td>
<td>5.785</td>
</tr>
<tr>
<td>Agile pedagogy</td>
<td>.411</td>
<td>.082</td>
<td>.451</td>
<td>4.989</td>
</tr>
</tbody>
</table>
To put it succinctly, an increase in endeavors related to lean pedagogy by one unit is likely to increase to 1.202 units in resilience. Similarly, a one-unit growth in endeavors related to agile pedagogy is expected to cause an increase of 0.411 units in resilience building in TVET institutions.

DISCUSSIONS

The COVID-19 pandemic led to the closure of educational institutions all over the world, and in Kenya, 17 million learners were impacted by the government’s decision to close schools and move instruction online. This disruption had cascading economic and social effects, exacerbating existing inequalities due to limited access to electricity and the Internet. This is why concerns were raised about the challenges faced by the education sector during the pandemic (Jelimo, 2020).

This study’s descriptive results provide further insights into how TVET institutions in Kenya responded to these challenges. They indicate that TVETs adopted lean and agile practices, often employed in industrial supply chains, to enhance resilience against disruptions like the pandemic. For example, TVETs designed courses focusing on beneficiaries and values, encouraged critical evaluation of training outcomes, and embraced continuous improvement. Additionally, they integrated agile practices such as knowledge sharing, collaborative training, and flexibility in training. These findings align with the concerns raised in the introduction about the adaptability of the TVET sector and resonate with literature highlighting the importance of agility in education during crises (Pandya, 2020).

Regarding reforms initiated in the education sector, including restructuring education and training into sub-sectors, the study’s findings indicate that TVET institutions in Kenya align with the Competency-Based Education and Training (CBET) curriculum, emphasizing practical experience and technical skills. This alignment suggests that the TVET sector is evolving in response to policy frameworks, which addresses the concerns raised in the introduction about the sector’s ability to adapt. These reforms are consistent with the policy changes to improve the quality and relevance of TVET in Kenya (Maina et al., 2017).

The need for resilience in the TVET sector has been emphasized, especially in the face of challenges like the pandemic. The study’s findings support this by showing that lean and agile pedagogy are positive and highly significant predictors of resilience building in TVET institutions. This finding implies that efforts to adopt these pedagogical approaches can contribute to the sector’s resilience. The specific details provided in the findings, such as the increase in resilience associated with a one-unit increase in lean or agile pedagogy, offer practical insights into how resilience can be enhanced. These findings align with the call for educational institutions to build resilience and adaptability in response to crises (UNESCO, 2020).

The study’s findings provide empirical evidence that aligns with and addresses the concerns raised in the introduction regarding the challenges faced by the TVET sector in Kenya during the COVID-19 pandemic. They also highlight the sector’s efforts to adapt and build resilience through pedagogical changes, which can serve as a model for similar contexts. These findings can inform policymakers and stakeholders in the education sector about the measures needed to enhance the resilience of TVET institutions, contributing to achieving sustainable development goals in education (UN, 2015b).

CONCLUSION

The participants’ demographics offer a vivid portrait of the TVET trainers in Kenya, painting a picture of a well-qualified and experienced workforce. The gender distribution is well-balanced, reflecting diversity in the profession. Most trainers possess bachelor’s degrees, and a significant proportion boasts extensive work experience of over a decade. These insights provide a valuable overview of
the qualifications and background of TVET trainers, underlining their capacity to adapt to changing educational landscapes.

There has been a profound transformation in the pedagogical approaches employed by TVET institutions in response to the COVID-19 pandemic. Embracing lean and agile practices commonly seen in industrial supply chains, these institutions prioritize values and beneficiaries when designing courses. They have cultivated a culture of critical evaluation, emphasized the elimination of waste, and encouraged trainees to assess the value of their outputs. Integrating agile practices such as knowledge sharing and collaborative training further underscores this commitment to continuous improvement and adaptability. These findings reveal the sector’s dedication to evolving and bolstering its resilience in adversity.

The inferential results provide quantitative evidence of the profound impact of lean and agile pedagogy on resilience within TVET institutions. Both lean and agile pedagogy emerge as robust predictors of resilience, highlighting the pivotal role of pedagogical innovation in fortifying TVET institutions against crises like the COVID-19 pandemic. These findings emphasize the critical importance of pedagogical transformations in ensuring the resilience and adaptability of TVET institutions, positioning them as key players in the dynamic landscape of education and workforce development.

**RECOMMENDATIONS**

TVET stakeholders and managers should prioritize several key recommendations to enhance the resilience and effectiveness of TVET institutions. Firstly, there is a critical need to embrace lean and agile pedagogy, fundamentally transforming teaching methodologies. This need entails designing courses that prioritize values and beneficiaries, fostering a culture of continuous improvement, and encouraging critical evaluation of training outcomes. Moreover, agile practices like knowledge sharing and collaborative training should be actively integrated to enhance adaptability and innovation in response to challenges.

Secondly, substantial investment in digital infrastructure is imperative. The COVID-19 pandemic underscored the digital divide, necessitating reliable internet access and electronic resources for equitable education delivery. This investment will enable effective online and blended learning, ensuring trainers and trainees can access educational materials and resources seamlessly.

Additionally, continuous professional development programs for TVET trainers are vital to equip them with evolving pedagogical approaches and digital tools, ultimately enhancing the quality of education provided.

Finally, maintaining a strong focus on quality assurance, including regular assessments and feedback mechanisms, is crucial to ensure that adopting lean and agile practices does not compromise educational standards.

**LIMITATIONS AND FUTURE RESEARCH**

One of the primary limitations of this study is the potential for sampling bias. The study focused on TVET trainers in a specific region of Kenya, which may not represent all TVET institutions in the country. While providing valuable insights, the sample size of 152 trainers might not fully capture the diversity of TVET trainers in Kenya. Additionally, the study excluded trainers who declined to participate or could not be reached, which could introduce a bias if these trainers differed significantly from those included. Future research should conduct a more extensive and geographically diverse study, encompassing a broader spectrum of TVET institutions across Kenya. By expanding the scope of the study, researchers can gain deeper insights into the unique challenges and practices within different regions and types of TVET institutions, allowing for more nuanced and generalizable findings.
Also, this study relied on self-reported data, which can be subject to social desirability bias. Trainers may have provided responses they believed were socially acceptable or aligned with the perceived expectations of the researchers. This bias could affect the accuracy of the reported pedagogical practices and resilience-building efforts. Future research could consider using more objective measures or triangulating self-report data with other sources to mitigate this limitation.

Finally, this study utilized a cross-sectional design, meaning that data was collected at a single time. While this approach provides a snapshot of the situation, it does not capture changes or trends. The findings may reflect the circumstances and practices during the specific data collection period but may not account for potential fluctuations or long-term developments. Future research could address this limitation by longitudinal designs to track changes and trends in TVET pedagogy and resilience-building efforts.

CONFLICT OF INTEREST
The author declares that there were no known competing financial interests or personal relationships that may have influenced the research reported in this paper.

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