



Digital Technology Integration Determinants and Implications for Student Performance in Ethiopian Technical and Vocational Education and Training Institutions: A Systematic Review

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Abstract

Digital transformation is increasingly influencing the Technical and Vocational Education and Training systems worldwide. National initiatives such as Digital Ethiopia 2030 and sectoral reforms in Ethiopia, shown by the basis of integration, have prioritized technology in education. Nevertheless, the evidence pointing to elements of successful digital technology integration in competency-based training and their association with student learning outcomes is limited across Ethiopian TVET institutions. The predictors of the integration of digital technologies in TVET-based competency training and their association with student learning outcomes, attainment of competencies, engagement, and digital readiness: a systematic review synthesizing empirical and policy evidence in Ethiopia. The review was conducted using the 2020 PRISMA guidelines. A systematic search was conducted in Google Scholar, Web of Science, Scopus, SpringerLink, and ERIC. Entered additional studies according to information from the identified papers/collectives. The review also included articles published from 2015 to 2026. We included 50 peer-reviewed studies and 12 policy documents. Data analysis was based on thematic synthesis, through a conceptual framework using UTAUT, TAM, and Self-Efficacy Theory and Activity Theory. Several noticeable predictors were identified from four domains (i) organizational factors, leadership, long-term funding commitments, and targeted technical assistance) (ii) technological aspects, including content aligned with curriculum, infrastructural reliability, and platform usability; (iii) human resource issues, such as student digital readiness, student digital preparedness, and facilitator capacity in using computers and platforms for teaching; and (iv) instructional aspects encompassing genuine online assessment.

These factors appear to impact students indirectly via aspects such as improved engagement, digital literacy, quality of instruction and feedback, and attainment of competencies. But synchronous interaction, institutional, technological, human, and pedagogical factors have relevance to the integration of digital technology with Ethiopian TVET. While there are still a few rigorous evaluations to show reliance on student outcomes, there is a growing and consistent body of evidence that effective digital integration with appropriate diagnosis can enhance learner-centered teaching approaches and leave students better prepared for the labor markets of tomorrow.

Subject Areas

Educational Technology

Keywords

Digital Technology, Determinants, Student performance, Ethiopian TVET, Institutions, Integration

1. Introduction

Educational systems worldwide are increasingly influenced by digitalization and are reshaping the ways of teaching, learning, and assessment, resulting in rapid change driven by digital transformation. In this global transition, TVET has a unique position in the education system, as TVET is expected to prepare learners with relevant skills that are practical, employable, & demand driven for changing labor markets [1]. In contrast with general academic training, TVET centers on skill acquisition through hands-on experience to prepare trainees for employment and certify them in their competencies. With sectors becoming more digital, TVET institutions are feeling the pressure to transform their educational processes by infusing numerous digital technologies, including learning management systems, virtual simulations, mobile learning platforms, digital assessment tools, and blended learning environments [2].

In all regions, digital technologies have been applied to reinforce TVET delivery in various ways. These include increasing availability to learning materials, providing simulated practical training, assisting competency tracking, enhancing assessment feedback mechanisms, supporting flexible learning, and strengthening the connections between the education/training sector and industry [3]. Evidence is beginning to point towards implementations of educational technologies that can promote student's engagement, ease of digital literacy tool acquisition, self-directed learning, and efficient instruction when applied correctly. But that does not come naturally [4]. The extent of their realization is reliant on the readiness of institutions, the quality of infrastructure, staffing capacity, preparedness students for digital technology integration, and alignment with curriculum reform, as well as long-term policy to support these strategies [5].

The transition is more difficult in digitally challenged developing countries when it pertains to TVET. The success rates of the different digital projects can be hindered by a scarcity of infrastructure, unreliable access to the internet, poor institutional budgets, lack of devices among students and teachers, or limited technical support and policy implementation in reality and so on [6]. Herein lies an opportunity that relates to these problems, which are particularly high-profile, where governments are throwing more money at education technology yet also face broader development constraints, not least in Sub-Saharan Africa. Thus, comprehending the factors galvanizing effective integration of digital technology in TVET holds substantial importance to ensure that investments convert into meaningful learning outcomes [7].

Ethiopia has recently been quite focused on policy in digital transformation. Digital skills development and technology-enabled education have been recognized as national priorities, in relation to national strategies including Digital Ethiopia 2030, the Digital Education Strategy (2023-2028), and reforms in the TVET sector. These initiatives show an appreciation that the contemporary labor force needs both job skills and digital skills [8] [9]. Thus, preparing youth for employment, entrepreneurship, and participation in a technology-driven economy is expected to be central to the mission of Ethiopian TVET institutions [10].

However, despite these policy commitments, evidence on how the integration of digital technology works within Ethiopian TVET institutions is limited. Previous research primarily discusses access to infrastructure, teachers' dispositions and practices, ICT readiness, or inhibitors of success in isolated instances of implementation [11]. Other studies across international settings have identified associations of positive relations between digital learning environments with student engagement, quality of feedback, development of competencies, and digital literacy [12]. Yet, few syntheses of the evidence have focused on CBT in Ethiopian TVET contexts. This leaves policymakers and institutional leaders with a fragmented evidence base to inform effective implementation [13].

CBT-the foundation of most TVET systems is focused on having evidence of different occupational competencies rather than time spent in classrooms [14]. This creates digital integrations and demands. E.g., the role of digital platforms that can facilitate continuous assessment, e-portfolios, simulated practice, and evidence collection from work-based learning, as well as more personalized learning pathways [15]. And yet, CBT also demands genuine assessment systems, teacher knowledge, and closely aligned technology tools with occupational standards. But without these, technology implementation will just be skin-deep and not lead to improved learning outcomes [16].

Another limitation in the literature is that different studies tend to measure different outcomes. Some also study acceptance or intention to use technologies, whereas others cover engagement, satisfaction, digital preparedness, or academic outcomes [17]. Thus, there is a need for a review to elaborate on the difference between the determinants of technology integration and educational outcomes

that may take place following successful implementation.

To this gap, this study analyzes the evidence on determining factors of integration in competency-based TVET contexts and their effects on students' achievement in institutions across Ethiopia through a systematic review.

2. Theoretical Framework

Analyzing learning technology integration in TVET offers an analytical framework which goes beyond the simplistic dichotomy of adoption-non-adoption. Existing literature on digital implementation in CBT environments: what works and for which aspects of digital implementation possibly does not reach the same level as the impact [18]. As a result, the present review identifies the factors that predict people's adoption of and willingness to use digital systems. By using a multi-theoretical framework, which includes Unified Technology Acceptance and Use of Technology as an overarching theory, further integrating Technology Acceptance Model with Self-Efficacy Theory and Activity Theory [19].

2.1. The objective for Integrating Theories

The objective of bringing these frameworks together is not to integrate them into one large theory but rather to treat them as mutually reinforcing analytical lenses that operate at different levels. Individual Acceptance and Use Behavior are primarily explained by TAM and UTAUT; confidence, capability beliefs are explained by Self-Efficacy Theory; and systematic, organizational, contextual dynamics are explained by Activity Theory. The combined utility of these models presents a common foundation for interpreting drivers of digital technology assimilation into Ethiopian TVET institutions [20] [21].

2.2. Technology Acceptance Model

Various models outline the acceptance of technology, such as the Technology Acceptance Model [17], which is one of the most widely used models for explaining user acceptance of technology. The theory of TAM proposed that acceptance of technology mainly depends on two beliefs, both of which are stimuli to which customers respond. Perceived usefulness is the extent to which a user believes that technology will enhance performance, and perceived ease of use is how easy users think it is to learn and use the technology. These constructs are pertinently related in TVET contexts. Digital tools may be used more frequently when teachers perceive the use of digital tools to lead to better delivery of instruction, assessment efficiency, or improved learning outcomes. When platforms are intuitive to use and add value, students will engage more with them. Hence, TAM is useful for interpreting findings on platform usability, user satisfaction, and willingness to adopt by users [7].

2.3. Unified Theory of Acceptance and Use of Technology

UTAUT is integrated with multiple drivers of use, extending previous acceptance

models. This is why it would be especially relevant in institutional cases such as TVET colleges, where the use of technology is not merely determined by personal dispositions but a collection of other contextual factors which include leader expectations, peer culture (and pressure), training opportunities, and technical support. By reviewing the UTAUT, factors are explained, such as leadership commitment, adoption by trainers, infrastructure support, and institutional readiness [22].

2.4. Self-Efficacy Theory

It is associated with a person's perception of their ability to be successful in activities. Computer self-efficacy, or digital self-efficacy in other words, how people feel and think about their capability to use computers, is one of the strongest predictors of whether teachers and students are prepared to try things out with technology, stick with it when it gets tricky, and use hardware effectively. Mastery experiences, vicarious experience/modeling, & Apprenticeship about self-efficacy: Reduced anxiety during performance of the task [23].

The relevance of this very theory is significant when we talk about Ethiopian TVET institutions because even at the user level, previous exposure to technology may not be fair. A long way, even with the devices there, low confidence can stop effective integration [24]. Thus, the Self-Efficacy Theory assists with understanding aspects of research outcomes that pertain to trainer competence, readiness for learning, confidence gaps, and those related professional development needs [25].

2.5. Activity Theory

It provides a larger socio-cultural and systemic view. Instead of only concentrating on single characteristics, Activity Theory understands technology use as something to be considered in the activity system composed of elements interacting with each other:

The notion of contradictions, structural connection impeding performance or driving change, is an important contribution from Activity Theory [26]. Some of the examples are: Technology is brought to the class without training for teachers, Digital Platforms are developed, but rules for assessment remain paper-based, Internet is provided in offices only and not in workshops, and Teachers have to innovate lectures over new technology but with no technical support. These types of contradictions are typical in developing-country TVET systems. This means that Activity Theory can help us understand why technology investments alone should not be expected to achieve student improvements. The above-mentioned ideas are the determining factors that directly or indirectly affect students' performance.

2.6. Analytical Model Integrated into this Review

In terms of their methodological clarity, the four theories were adopted to sort findings into four review dimensions. This ensures that they are not just back-

ground literature but actively contribute to the synthesis. (See **Table 1**).

Table 1. Analytical model.

S/n	Dimension	Determinants	Theory lens
1	Institutional issues	Leadership, technical support, and funding.	UTAUT/Activity theory
2	Technological issues	Infrastructure, usability, and content alignment.	TAM/UTAUT
3	Human issues	Students' readiness, motivation, and teachers' competence and motivation.	Self-efficacy theory
4	Pedagogical issues	Instructional use and authentic assessment.	Activity theory/TAM

2.7. Ethiopian TVET Context

The Ethiopian TVET sector is in the process of modernization under national digital transformation policies. But they are implemented in contexts with uneven infrastructure, low budgets, and staff presence, and urban-rural asymmetry. In this sense, TAM explains whether users perceive the technologies as useful or not useful, UTAUT gives you an insight into how institutional habits adopt the resource systemically, and Self-Efficacy clarifies gaps of readiness and confidence, which means information may never fill in the blanks for a person. In contrast, Activity Theory unimpeachably portrays systemic restrictions and contradictions. These lenses provide particularly rich terrain to interpret how technology is integrated into Ethiopian competency-based training delivery environments [27].

2.8. Theoretical Proposition of the Review

Given the integrated model framework, this review assumes that digital technology alone does not affect student performance. Instead, well-purposed but incompatible conditions, unused technologies, and good users may have a depressant effect on student outcomes. In this way, technology acts as an enabling device, one whose workings are situational and contextual.

3. Methodology

3.1. Review Design

The current study used a systematic review design to collate accessible empirical and policy evidence on factors affecting digital technologies integration and their impacts on students' performance in Ethiopian Technical and Vocational Education and Training (TVET) institutions [28]. Taking into account that the literature is split across fields of scholarship such as education, technology, development, and vocational training, to synthesize existing evidence in a systematic fashion, a systematic review approach was utilized.

To promote transparency, replicability, and rigorous research, the review was conducted and reported in line with the PRISMA 2020 statement [3]. Identifica-

tion, screening, eligibility assessment, quality appraisal, data extraction, and thematic synthesis of the review.

3.2. Search Strategy and Terms

A keyword search was conducted to locate peer-reviewed studies, policies, and report documents published from 2015 to 2026.

The following databases were searched: Google Scholar, Scopus, Web of Science, Education Resources Information Center (ERIC), SpringerLink, and Wiley Online Library. We selected these databases because they have a broad reach across the educational literature, as they publish reviews of education, technology (including games), workforce learning, and education policy [29].

Searches encompassed variations of keywords and Boolean operators, including digital technology or ICT, educational technology or e-learning, blended learning, or LMS, and TVET or technical education. It is sometimes called vocational education or occupational training. Competency, or competency-based training, or outcome-based education, or digital literacy, or competency attainment, and Ethiopia, or Africa, or developing countries, and student performance, or learning outcomes, or engagement. Also, manually searched reference lists of included articles to identify further applicable studies [30].

3.3. Literature Search

Books, Reports, Articles to capture contextual policy evidence. Official Documents were searched from the Ethiopian Ministry of Education, Ministry of Labor and Skills, Ministry of Innovation and Technology, UNESCO-UNEVOC, World Bank, GIZ, OECD & European Union sources [31].

3.4. Eligibility Criteria

In terms of broadening the inclusion criteria to overcome identified conceptual inconsistencies in previous drafts, direct performance studies and technology integration determinants associated with learning delivery were included as eligible studies [32].

Inclusion Criteria: Studies were included if they focused on TVET, vocational education or competency-based training contexts, examined digital technology integration, adoption, implementation or usage; reported at least one of the following outcomes (student academic performance, competency attainment, learner engagement, digital literacy/readiness for learning/instructional effectiveness); provided evidence specifically concerning Ethiopia or transferable lessons learnt from comparable contexts; and publication waves between 2015 and 2026 in English language peer-reviewed articles including conference papers, book chapters or official policy documents [33].

Exclusion Criteria: Studies are excluded if they: Were primarily on general education with no relevance to TVET, weren't related to educational application of the infrastructure only, were case studies, editorials, opinion pieces, or non-evidence commentaries, didn't have any reference to digital technologies within a

learning/teaching/training context, or were duplicates [34].

Study Selection: Identified records were exported to a screening spreadsheet. Records were deduplicated, selected by title and abstract screening for documented outcome(s) on mortality outcomes, and full-text review of potentially eligible studies, since the disagreements in screening results were reconciled through multiple reviews relative to eligibility criteria [35].

Table 2 displays the PRISMA flow. The database search identified 615 records. Moreover, an additional 23 records were identified manually. The total number of records identified was 638. Duplicates removed numbered 170. A total of records were screened by title and abstract 468. The number of records excluded during screening was 390. Full-text articles assessed numbered 78. Full-text articles excluded numbered 16. Final sources numbered [36].

Table 2. PRISMA flow summary.

S/n	Phase	Recorded
1	Articles recognized records through searching	615
2	Articles manually identified extra records	23
3	Articles overall selected records	638
4	Articles rejected duplications	170
5	Screened titles and abstracts	468
6	Articles records omitted after screening	390
7	Articles fully evaluated articles	78
8	Articles fully excluded articles	16
9	Final included sources	62

So all in all, Final included articles N = 62 (50 peer-reviewed journal papers, 5 conference proceedings/book chapters & 7 policy/institutional reports)

3.5. Data Extraction and Synthesis

Data captured included: Author(s) and year, country/context, study design, type of digital technology, theoretical framework used, determinants of integration, and main recommendations (standardized extraction framework) [37].

Following a thematic synthesis approach with Braun and Clarke's six-phase model, we performed the following after familiarization with studies, among others: initial coding, searching for themes and reviewing them, and producing a synthesis narrative. Codes were then aggregated to four analytical dimensions aligned with the theoretical framework-factors of institution, technology, human, and pedagogical factors [38].

3.6. Addressing Bias

Several steps to reduce bias were taken: multiple databases searched, grey litera-

ture included, clear criteria developed and applied, quality appraisal process conducted, contradictory findings retained but treated with caution, and policy sources distinguished from empirical studies [39].

4. Results

4.1. Overview of Included Evidence

Final synthesis included 62 sources, comprised of 50 peer-reviewed journal articles, and 12 sources as conference/book chapters or policy/institutional reports. Data were represented from Ethiopia alongside similar international settings: Sub-Saharan Africa, Europe, Asia, and Australia. The majority of empirical studies used cross-sectional surveys, descriptive, mixed-method, or case study designs.

The literature also examined a range of digital technologies, for instance: Learning Management Systems (LMS), mobile learning platforms, video-conferencing applications, simulation technology, computer-assisted training software, e-portfolios and digital assessment frameworks, blended learning platforms, and online repositories or open educational resources [40].

A thematic synthesis identified and categorized the four major determinants influencing digital technology integration into four dimensions, which are: Institutional factors, technological factors, human factors, and pedagogical factors. In addition, robust evidence was found across various student outcomes, including engagement and digital literacy, competency attainment, and quality of instruction.

While fewer studies directly measured examination marks or the impact of effective digital integration on more sustained indicators of academic achievement, many more indicated positive relationships between effective measurements and markers of student performance at large [41].

Learners' engagement and participation: Several studies showed blended and technology-based learning environments have improved student engagement, motivation, and collaboration. Multimedia content of any type, mobile application learning tools, and interactive learning platforms had students attend the sessions regularly, submit assigned work on time, and participate in practical learning tasks. Such effects have been shown to operate in competency-based training that requires active participation for skill acquisition [17].

Readiness in the Work Environment and Digital Literacy: Multiple studies showed that mainly the basic ICT skills, online communication, and digital literacy improved among students, as well as their confidence in technology and digital problem-solving. In TVET systems, these competencies are becoming more crucial since modern workplaces make use of both occupational and digital skills. As a result, digital integration is often associated with higher employability preparedness [42] [43].

Competency Attainment: Improvements in competency tracking and skill acquisition were reported, though studies involved simulations, predominantly guided tutorials, e-portfolios, and ongoing digital feedback. When technologies permit-

ted repeated practice, stepwise demonstrations, and more rapid corrective feedback, this was beneficial for students. That was most useful in technical trades where procedural accuracy is important [44].

4.1.1. Institutional Determinants

Institutional conditions were tested and found to be among the best predictors of successful embedding of digital technology [45].

Leadership Commitment: We found that stronger institutional leadership has been statistically significantly correlated with more effective implementation throughout. These institutions, where leaders intentionally push for innovation, organize funding and monitoring of implementation, and induce staff involvement, see greater use of technology. Student achievement was indirectly affected by better preparation, increasing teacher support, and continued implementation due to commitment from leadership [46].

Technical Support Systems: Continued use was considerably influenced by on-site ICT technicians or supportive staff being readily available. Teachers, who found themselves with technical issues that they could not resolve, often used technology less. Support systems that were well-documented provided a crucial lifeline between access and real-world implementation in the classroom [47].

4.1.2. Technological Determinants

Infrastructure Reliability: We consistently identified reliable electricity, internet connectivity, functioning devices, and access in the classroom as necessary conditions. In developing-country settings, a pervasive issue was to have access to the internet at the administrative office but not the workshops or classrooms where learning took place. This limits pedagogical use [48].

Curriculum-Aligned Digital Content: Best utilisation of technology was when the digital resources were aligned with competency standards, occupational modules, and assessment requirements. Irrelevant or ill-aligned content led to a loss of meaningfulness and engagement for students [49].

Platform Usability: We identified ease of use as a heavy driver for both teacher adoption and student engagement. Systems that are complex to navigate routinely force a login or role up performance issues lived mainly unused. In comparison, plain mobile-friendly solutions gained decent traction [50].

4.1.3. Human Determinants

Trainer Digital Competence: One of the strongest influences was teacher capability. It was evident that technology integration was not simply reliant upon an understanding of basic ICT skills; rather, it was equally contingent on pedagogical knowledge and understanding of how to integrate technology into instructional, assessment, and competency-based practice. Several studies reported on a double challenge: some of the younger instructors were technically familiar with digital technologies, but had limited pedagogical integration skills; and some experienced instructors had high confidence in their teaching strategies but lower levels of dig-

ital confidence [51].

Student Digital Readiness: As per the past exposure, the socio-economic background, location of being, and gender student laidness. Digital learning opportunities benefited more those learners who had been exposed to ICTs at home. In some cases, technology reinforced prevailing disparities without bridging support [52].

4.1.4. Pedagogical Determinants

Competency-based learning relies heavily on demonstration of competencies in practice. Various studies have reported that digital assessment tools improve: Immediate feedback, tracking of progress, evidence collection and transparency in grading, and competency verification. Such systems were more closely aligned with CBT principles than the traditional paper-based examinations held once [53].

Quality of Instructional Integration: Learning did get better, but only by virtue of the technology itself. The tools were used best when they were used wisely: Simulations for skills, Video demonstrations, quizzes for feedback, and blended learning to facilitate theory-practice balance. The benefits of passive digitization of lecture notes were less pronounced [54].

Ethiopia-Specific Findings: In the case of Ethiopian TVET institutions, it stressed the following issues: inconsistent internet access; electricity coverage in parts of the country (literally) non-existent; over promise and under delivery of institutional budgets for training that they do not receive funding to implement from government/funder sources, etc.; very few IT staff/technical support personnel available to institutions. However, a substantial amount of positive policy momentum and various high-potential pilot programs were showing an ever-growing commitment to digital transformation in many institutions [4].

Overall Interpretation of Results: Digital technology integration was most successful when institutional support, usable technology, capable users, and sound pedagogy co-existed across studies. Most of the time, technology was just not enough. On the whole, gains in student outcomes were due to higher engagement, better digital literacy and competency practice, as well as feedback systems; from the exam-score improvement perspective, that was not a factor.

5. Discussion

5.1. Overview of Key Findings

This systematic review aims to examine the determinants for integrating digital technology and its impact on student performance in Ethiopian TVET institutions. The findings reveal that a unique interplay of institutional, technological, human, and pedagogical factors conditions successful digital transformation in CBT. Overall, among the studies that were reviewed, evidence of automatic improvement in outcomes with technology was rare. Instead, successful uses of digital tools to improve student achievement were most likely when certain condi-

tions had been met, including leadership, reliable infrastructure, proficient teachers, learners prepared with skills and attitudes, and carefully designed instruction.

One of the review's central contributions is a differentiation between technology presence and technology effectiveness. Both the presence of devices, internet connection, or software systems, and even access to them, would not actually mean any meaningful learning benefits, just because support systems are weak. The finding follows a long tradition of educational technology underachievement in international literature, when capacity for implementation is ignored [55].

5.2. Interpretation of Determinants

The Role and Importance of Institutional Conditions as the Basic Driving Forces

The results demonstrated leadership commitment, sustainable financing, and technical support to be key building blocks. Thus, these factors affect whether technological initiatives are implemented only in pilot stages or become part of stable institutional practice. This is particularly significant in TVET environments, where practical training requires specialized equipment and ongoing maintenance, given the institutional commitment to such an extent. Which means, digital transformation in Ethiopian TVET institutions is an organizational reform, not just a procurement exercise. Buying hardware with no budget for maintenance, training, or support will not create long-term benefits for students [56].

Human Capacity: Some of the strongest mediators were trainer competence and student readiness. Where infrastructure is in place, teachers who are not confident or do not possess quality pedagogical digital skills may underutilise technology. Also, students who have not used ICT much before might fail to utilize online systems or assignments in a successful way. These results are consistent with Self-Efficacy Theory in that confidence and capability beliefs drive behavior. On a practical level, more human capacity investments may yield the same or higher returns as just hardware investment.

Pedagogy Determines Educational Value: The review also supports that learning outcomes are inextricably linked to the pedagogical approaches at play. It became more impactful when incorporated as part of competency-based pedagogy, namely, through synergies of simulations, real-time feedback systems, digital portfolios, guided practice, and blended learning models.

In comparison, passive uses, e.g., uploading lecture notes online, which did not involve interaction, were found to be, to a greater extent, educationally ineffective. This distinction is pertinent to TVET in particular, given that competency attainment necessitates display, rehearsal, and authentic assessment rather than the passive consumption of content.

Implications for Student Performance: The number of available studies providing direct evidence that digital technology is associated with exam performance or certification rates was limited across many studies. There were far more indirect paths along which technology could enhance student outcomes. Such rails

include more learner engagement and participation, better access to the learning, a stronger base for digital literacy formation, faster feedback loops, better competencies tracking, and eventually time-and-pace flexibility in how students learn.

Hence, student performance is widely recognized in the TVET environment that not only emphasizes the test score but also competency mastery together with employability readiness, practical skills development, and adaptability to learning behavior [57].

Comparison with International Practice: The results of this review conform largely to the developed digital TVET systems tend to have many characteristics in common: stability of policy over time; ongoing professional development for training providers; industry relevant and endorsed digital content aligned to the skills framework/competencies.; blended/hybrid delivery models of training; real-world authenticity in the practical implementation of a robust system of digital assessment; and institutional data systems that capture learner outcomes.

The successful examples of China, Germany, Finland, Singapore, and other systems imply that technology-oriented TVET digitalization should be accompanied by curriculum reform to make it work by aligning with the workforce. For Ethiopia, this means that it may not be enough to pay attention to ICT initiatives in isolation, but as a part of the TVET modernization process [55].

6. Recommendations

In this section, we give recommendations to policymakers, TVET leaders, development actors, and practitioners on how digital technology should be used (*i.e.*, implemented) in Ethiopian TVET institutions; the recommendations were mainly derived from the findings of evidence synthesised in this review process.

National Policy-Level Recommendations

Framework for Dedicated Digital TVET Implementation: While there are national digital strategies developed in Ethiopia, a sectoral framework for TVET to implement its digitalization is lacking. With this, a framework must be established, including: Infrastructure standards, Digital pedagogy priorities, Instructor competency benchmarks, Assessment modernization targets, Monitoring indicators, and Phased rollout pathways.

Introduce Sustainable Financing Mechanisms: Technology reform must be freed from donor dependence on project scale. Government and institutions should create recurring budgets for Connectivity Maintenance Device Cycle, Technical Support Staff, Software & Platforms Staff Training.

Address Regional Disparity: Directed funding mechanisms to regional institutions, both under-resourced and lacking in readiness, should be implemented where infrastructure and need are greatest.

Recommendations for TVET Colleges at the Institutional Level: Focus on the classroom, not on the office: Access to the internet and devices should only reach offices after workshops, laboratories, training rooms, and student practice areas [58].

Establish Digital Transformation Committees at Your Organization: The framework enables every TVET institution to create its own committee comprising the five elements below: Management, faculty, ICT staff, student representatives, and industry partners.

Human Capacity Recommendations

Reform Instructor Training for Faculty Professional Development: Move beyond basic computer literacy toward Blended learning design, Simulation-based teaching, Competency tracking tools, Digital assessment, and the use of technology that fosters inclusivity. In doing this, a framework needs to be defined, which sets out infrastructure standards, identifies digital pedagogy priorities, an instructor competency benchmarks assessment, modernization targets, and monitoring indicators, in addition to phased rollout pathways [59].

Introduce Sustainable Financing Mechanisms

In line with Competency-based Training: Push technologies should be additional E-portfolios/Digital logbook/Competency dashboard/Simulation software/Instant-Feedback quiz and Modular Learning system. Promote Blended Learning Models. Due to the uncertainty around connectivity, mixed methods systems (in facetime and electronic support) are more deployable than completely online models.

Transform assessment systems: Institutions can take cautious steps toward high-stakes, morbid-centric digital evaluation platforms that enable tracking of evidence capture, validation of skill, course correction feedback from the learner, and ongoing monitoring.

Conflicts of Interest

The authors declare no conflicts of interest.

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