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Virtual and Augmented Reality for Bridging Vocational Skills Gaps: A Systematic Review and its Implications for Tanzania

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Abstract

The gap between vocational education and training (VET) provision and the actual requirements of both employers and the job market gives Tanzania great concern in the context of workforce development. In industry 4.0 revolution era, traditional systems of VET training do not prepare the graduates for the requirements of the employers and the labour market at large. Therefore, the use of Virtual and Augmented Reality (VR and AR) is deemed as a panacea to this skills mismatch. This study employed integrated design of systematic review of literature aiming to explore the prospects and hurdles of using VR and AR on narrowing VET skill gaps and matching training outcomes to industry requirements. The review included 35 empirical research works published between 2015 and 2025 in SCOPUS, SPRINGER and ERIC platforms using the PRISMA 2020 method. This study brings together the global and regional evidences on the pedagogical, institutional, and policy-oriented aspects of VET and immersive technologies. The results show that the use of VR and AR in VET helps learners assimilate skills better through simulations of workplace experiences, thus bridging the gap between the industry and VET institutions. However, the adoption of such technologies in Tanzania is hampered by the high costs of the technologies, poor infrastructure, and insufficient preparation of trainers. The study suggests public-private partnerships, innovation ecosystems, and targeted capacity building for the sustainable incorporation of VR and AR technologies in transforming VET systems in Sub-Saharan Africa including Tanzania.

Keywords: virtual reality, augmented reality, immersive technologies, VET, Tanzania, skill gap

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1. Introduction

The underlining issue of the mismatch between VET system and the skill demands of the industry is a common phenomenon globally, especially with the onset of industry 4.0, and the current digital transformation (World Economic Forum, 2023). In developing countries, such as Tanzania, the gaps between VET provisions and the labor market are of great concern (African Development Bank, 2022). VET institutions are meant to equip the trainees with the knowledge and skills that would make them economically productive. However, employers are commonly reporting a lack of capability in technical skills, digital skills, and problem-solving skills (UNESCO-UNEVOC, 2024). Such gaps tend to reduce the productivity of the nation, and at the same time reduce job opportunities available for the youth. This results in an increase of the underemployment and informal employment issue globally (ILO, 2021).

The Tanzanian government has made strides toward reforming the VET sector through policies emphasizing competency-based training (Ministry of Education, 2021). However, lack of implementation is still an issue with archaic curricula, inadequate teaching materials, and fragile connections between training institutions and industry collaborators (Ministry of Education, 2025). With the need of the global labor market for flexible workers knowledgeable in technology, the conventional methods of teaching that are solely based on textbooks and workshop paradigm are insufficient (Kayembe & Nel, 2019). Thus, plentiful digital education resources, for example, VR and AR have availed more possibilities of real-world hands-on training that is devoid of immersion.

The developed technologies of VR and AR have increased in use all around the world and are recognized as game changing technologies for VET. VR creates an artificial environment in which the learner becomes active and is able to interact with simulated real-world scenarios, whereas AR integrates digital elements with real-world environments in order to improve learning activities (Radianti et al., 2020). These technologies help to create an effective learning environment that enables the acquisition of skills and the development of knowledge through practice, which is one of the most important aspects of VET learning. Research has shown that VR and AR technologies not only improve engagement but also retention, as well as the development of advanced order and cognitive psychomotor skills (Bicalho et al., 2023). In developed countries, VR and AR have started to transform technical training in fields such as manufacturing, healthcare and engineering (Ravichandran & Mahapatra, 2023). For example, VR assisted automotive maintenance modules have proven to enhance learner accuracy and proficiency (Quevedo et al., 2017). Nevertheless, VR and AR adoption into the African VET systems is still in the infancy stages. Despite the increasing enthusiasm, the majority of Sub-Saharan Africa is deficient in the necessary infrastructure, funding, and trainer knowledge required to embed immersive learning (Gewer, 2021). Tanzania is illustrative of this problem. It has strong policy intent but this has weak operational implementation, which is confined to pilot initiatives in a few polytechnics.

Tanzania's VET sector faces a threefold challenge: slow adoption of modern learning technologies, inadequate alignment of training outcomes with industry needs, and poorly developed supporting policies. As referenced by the African Development Bank (2022), 25% of the VET institutions in Tanzania claim to regularly engage with industry contacts, and the majority operate with ancient training methods. Consequently, graduates are eager to enter the workforce, but they are unable to compete in the technical areas of the economy, such as energy, manufacturing, and information technology (UNESCO, 2025). Sufficient modern and affordable learning environments, modelled around real-world industrial settings, are possible with the merger of VR and AR (Radianti et al., 2020).

Despite the benefits of VR and AR technologies in VET, there is no evidence to show effective use of immersive technologies in VET skills trainings in Tanzania. This paper aims to systematically consolidate and compile the international publications concerning the application of VR and AR to industry-driven VET and derive relevant lessons for Tanzanian VET. The study is guided by the research question "What are the prospects, hurdles, and policy strategies for integrating virtual and augmented reality technologies into Tanzania's VET system to alleviate skill mismatches and enhance labor market outcomes?" The research question was further split into the following sub questions to address the study objectives.

i. What are the available evidences on the pedagogical impact on application of VR/AR innovations in VET at the global scale?
ii. What ways do VR/AR technologies optimized VET skills and employability outcomes?
iii. How have VR/AR technologies alleviated the gap between the training and the industry's requirements?
iv. What contextual issues impact the use of VR/AR in VET system?
v. What policies can support the practical integration of immersive technologies in the VET ecosystem of Tanzania?

2. Materials and Methods

The methodology of this study was based on PRISMA. The authors regarded all empirical studies of any design as eligible and other articles like dissertations and editorials were excluded.

2.1. Research Design

This study adopted integrated design of systematic review as all studies were grouped for synthesis and findings were viewed to respond the same research question and sub questions of this study (Sandelowski et al., 2006). This is well suited to the problem at hand, as the adoption of VR and AR in VET is an emergent and fragmented field, and there are few attempts to synthesize the ways through which these technologies can address the institute–industry skill mismatches in the lower- and middle-income countries, especially Tanzania. Search stages, screening, inclusion and exclusion, and data extraction and synthesis have also been carefully and systematically recorded as described by Page et al. (2021).

2.2. Search Strategy

The search strategy focused on published peer-reviewed articles from 2015 to 2025. This boundary allowed us to trace the development of immersive technology from the time it existed as a set of prototypes to its current commercially available position in education specifically VET. Searches for relevant studies were conducted from three databases; SCOPUS, SPRINGER NATURE LINK and ERIC. We developed a search protocol that ensured all research sub-questions were included. In order to get a rigor, we managed all research sub-questions by using Boolean strings. The search terms used were (virtual reality OR augmented reality OR mixed reality OR immersive technology OR XR OR extended reality) AND (vocational education OR vocational training OR TVET OR technical education OR career education) AND (skills gap OR industry alignment OR employability OR skills acquisition OR implementation OR barrier OR policy OR effectiveness). All these search strings were modified according to individual database suitability.

2.3. Screening Process, Quality Assessment and Data Extraction

The review process adopted PRISMA guidelines advocated by (Page et al., 2021). The number of papers examined at each level of identification, screening, assessment and inclusion are shown. The initial search from database resulted into 681 articles. The articles were exported into Mendeley software for deduplication process. This stage excluded 29 duplicated articles and 232 articles were removed because they were ineligible. The articles which were identified for screening were exported into excel sheet and were examined by researchers. The inclusion and exclusion standards were used to include and exclude articles. This stage excluded 312 records which did not meet established standards. After screening 108 articles were eligible for retrieval. However,9 articles were not retrieved. Therefore, 99 articles qualified for quality assessment. Based on the nature of this review, studies using mixed, qualitative, and quantitative methods were regarded as empirical studies, thus the Mixed Methods Appraisal Tool (MMAT) was utilized to assess the quality of articles (Hong et al., 2018). This tool places empirical research according to their study design into five groups with five basic quality criteria and methodological requirements. These classifications include (i) qualitative, (ii) randomized controlled, (iii) non-randomized, (iv) quantitative descriptive, and (v) mixed approaches (Hong et al., 2018). This stage resulted into removal of 64 articles as they did not meet MMAT criteria, therefore 35 articles were included in this study.

2.4. Inclusion and Exclusion Criteria

In order to minimize subjective judgement of the searched articles, the inclusion and exclusion criteria were established by all authors. The established inclusion criteria aligned with standard framework of this study. In contrast, the articles which did not conform to established criteria were excluded. Table 1 presents the inclusion and exclusion criteria used in this review. Notably, only peer-reviewed journal articles in English, published between 2015 and 2025, and focusing on VR, AR, or XR in VET contexts, were included. Conference proceedings, dissertations, and non-English publications were excluded. The inclusion and exclusion standards aimed to maintain relevance and quality.

2.5. Data Extraction and Synthesis

A standardized form for data extraction was developed by the researchers. This form reduced the risk of subjective interpretation and the omission of crucial information and extracted data was cross-validated (Goodwin & Behan, 2023). The synthesis developed was a narrative thematic synthesis, appropriate for the integration of qualitative, quantitative and mixed research approaches. In the model put forth by (Thomas & Harden, 2008), the synthesis is completed in three stages: (i) coding the data, extracting and noting patterns; (ii) establishing descriptive themes, for instance, pedagogical value of VR, institutional preparedness, and policy barriers (iii) developing analytical themes that answer the review questions and patterns identified in the previous stages. The four main aspects that arose from this process were: (a) sustained pedagogical development through immersion in experiential learning (b) institutional and technological facilitators of adoption (c) socioeconomic and infrastructural constraints in developing contexts (d) sustainable integration through links between the institute and industry.

Table l. *Inclusion and exclusion criteria*

Inclusion	Exclusion
Research articles focusing VET studies at technical colleges, apprenticeship, skills training and labour force development.	Research articles related with academic or theoretical education without VET component.
Research studies documenting the use of VR, AR and XR technologies.	Research articles focused on superficial technologies like online videos and e-learning and studies employed VR, AR and MR in other types of training
Research articles devoted at least in one arca among pedagogy skills development, employability, skill gap alleviation, developing countries, VET and VR, AR and XR policy integration	Research articles with irrelevant focus to core themes of the study like pedagogy, skill development, employability and bridging the skill gap
Journal articles published from 2015 1o 2025	Research articles published before 2015
Peer reviewed research articles	Papers focused on conference proceedings, review articles like systematic reviews, reports, dissertations, editorials, book chapters and duplicates.
Research articles published in English language	Research articles published in non-English

3. Results

This section presents the findings in two groups. Firstly, we present descriptive statistics about the application of VR, AR and XR in VET and then thematic description of distribution of the 35 included studies. The main findings are given in tables and descriptions. The authors got 681 empirical studies from the searched databases; these were then screened for full-text retrieval after being cleared of duplicate entries. 312 studies were eliminated during screening process leaving 108 records whereby 9 studies were not fully accessed. Then, the sample of 99 studies were evaluated for eligibility. Finally, this Systematic Literature Review included 35 studies. Figure 1 presents the complete process of identification, screening and inclusion of the published papers for this study.

3.1. Descriptive Statistics of the Sample

Figure 2 shows the annual publication trend from 2020 to 2025. Publication numbers rose steadily from fewer than five articles in 2020 to a peak in 2025, confirming a clear upward trend in scholarly attention to this field. As Figure 2 illustrates, the growth is most pronounced after

2022. Furthermore, the result shows that Indonesia leads with the highest number of studies, followed by Germany and Switzerland in Europe, and that Africa and South America are entirely unrepresented. Figure 3 indicates that Indonesia is leading in publications which imply that the country has been very active in research about VR and AR in VET.

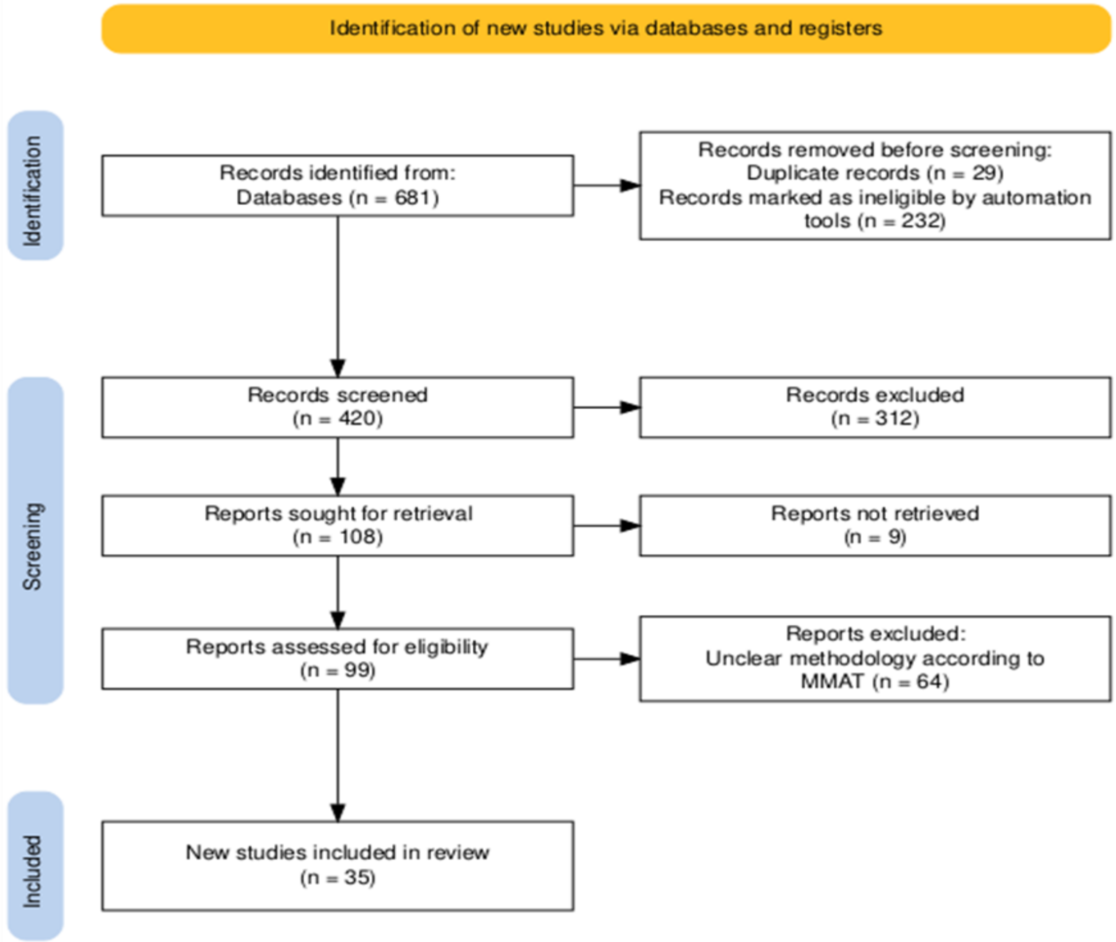

Figure 1. *PRISMA flow chart for inclusion and exclusion of studies*

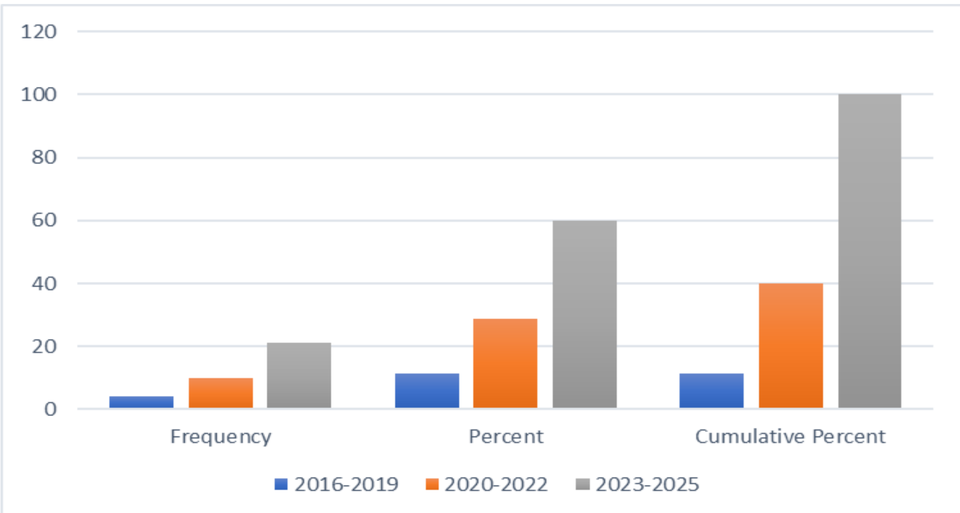

Figure 2. *Publications by years*

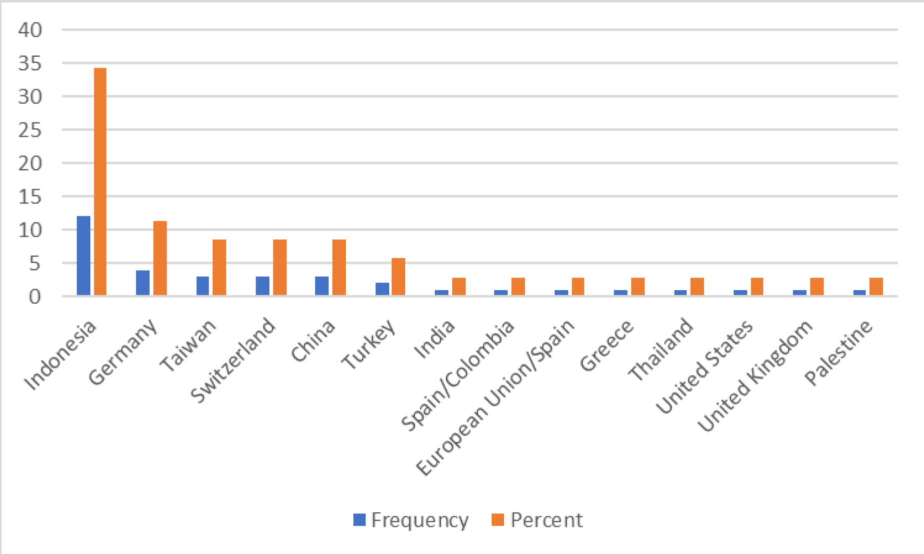

Figure 3. *VR/AR studies distribution by countries*

Moreover, the result indicates that VR, AR and MR technology applications are present in many countries, however AR and VR are the most immersive technologies researched by many scholars. Figure 4 justifies that AR and VR are commonly used to demonstrate a step-by-step instruction on the real equipment and practice dangerous or expensive task that it would be unsafe or even impossible to practice in the real world. Mixed or extended or combined reality is the most recent and combines hands-on work with information on the computer. Figure 5 shows that the most common VR/AR research in VET is found in general VET training, followed by engineering sector meanwhile logistics and music are less common. Additionally, the research findings were examined in compliance with the employed research methodology. Figure 6 presents that most of the included research papers used experimental approach, whereas the fewest employed qualitative ones.

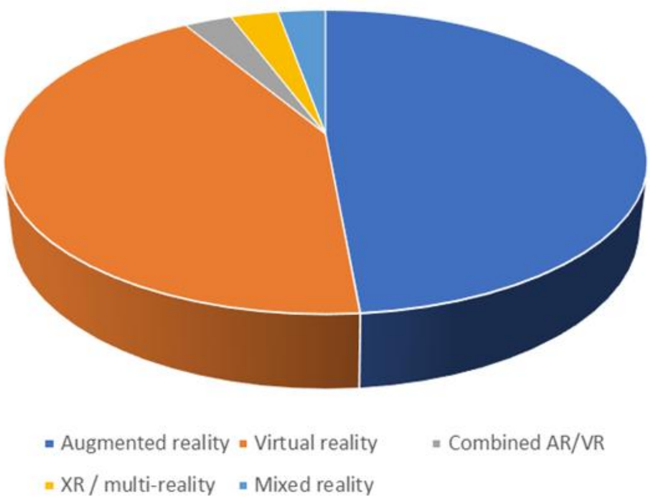

Figure 4. *Distribution by type of technologies*

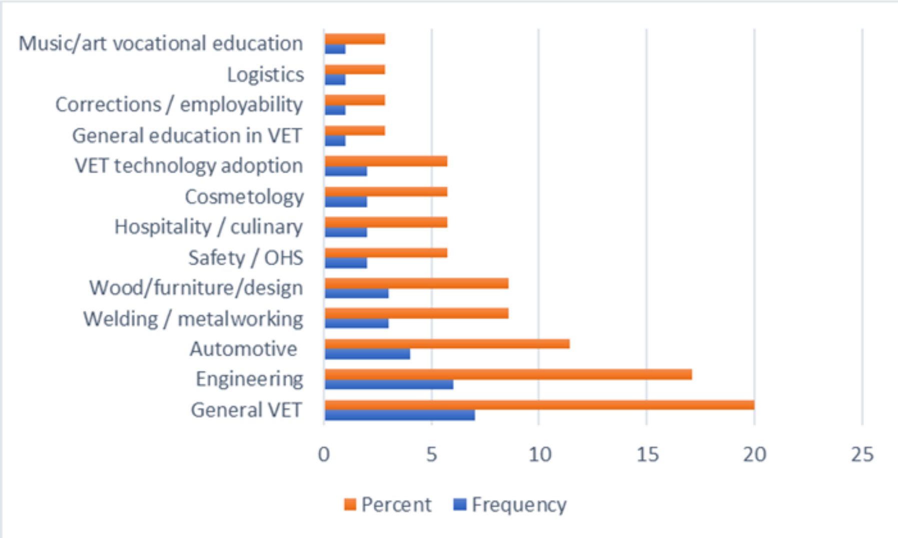

Figure 5. *Distribution by VET sectors*

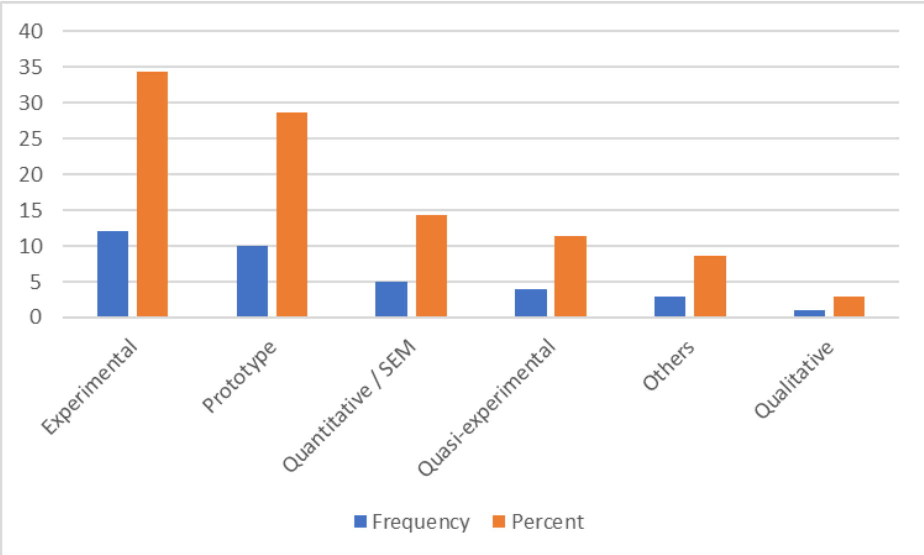

Figure 6. *Distribution by methodology*

3.2. Thematic Descriptions

Two authors independently examined the titles and abstracts of the retrieved articles to determine which ones qualified for full-text screening. In order to resolve disagreements occurred over the criteria for inclusion and removal, a team discussion was used. To confirm and guarantee the dependability of the exercise, the entire text screening and data extraction process was repeated. Following the thematic data analysis procedure, the first four research questions were used to identify thematic findings from the included papers.

Findings based on RQ1 about the pedagogical impact on application of VR/AR innovations in VET. The evidences from the included studies show that learners who used VR and AR interventions improved technical skills, procedural accuracy, and knowledge to the content targeted (Ajith Benson et al., 2016;Sirakaya & Cakmak, 2018;Lester & Hofmann, 2020). The results indicate that there were improved practices (Purnomo et al., 2025;Sukaridhoto et al., 2023) and improved performance on procedural tasks like hair-braid (Chiang et al., 2025). A number of studies showed improvement in psychomotor activities, like welding and assembly, aided with AR visual overlays (Wulansari et al., 2024). The findings from Keller et al. (2025) and Tian & Tian (2025) report that students who were active in VR simulations expressed higher levels of motivation and presence than in other instructional practices. Such effects were also noted in the VR-based psychological resilience training and practical modules involving AR (Hermansyah et al., 2025).

Findings based on RQ2 about the ways VR/AR technologies optimized VET skills and employability outcomes. The results show that VR/AR help in overcoming the classroom-industry distance and increase the potential of the real-life implementation (Abushamseieh; Mousa 2024). Also, the results indicate that VR/AR training were used to acquire professional skills on vehicle painting (Mulders, 2022; Mulders et al., 2024), future welding (Ajith Benson et al., 2016), procedural learning in a workplace environment (Candido et al., 2023) and actual procedures that minimize the risks of accidents in real employment (Hülagü & Erkarslan, 2021; Yunus et al., 2025) which are applicable in the real-life jobs. Furthermore, the results indicate that AR model enhances the survival skills of students so that they can either be employed or become self-employed (Purnomo et al., 2025). However, transfer at workplace is not a calculated effect but a by-product. The employability is not generally measured directly as it reported by Smith et al. (2020) who used job offer and recidivism and Purnomo et al. (2025) used survival skills. The connection is through skill-based training that simulate tasks in the real world implying some implicit presumption that the higher the skill-based training, the higher the employment preparation.

Findings based on RQ3 about VR/AR technologies to alleviate the gap between the training and the industry’s requirements. The results from the reviewed studies indicate that immersive technologies address more defined gaps in VET skills, particularly when training aligns with practice. For instance, Wulansari et al. (2024) demonstrated VR-enabled simulations of electrical distribution and enhanced manufacturing processes where students were able to practice workplace tasks in a safe and repetitive manner. Studies on industry integration content by Keller et al., (2025) and Long et al. (2025) report stronger learning gains and relevance perceptions, meaning that co-designed XR modules are more effective than generic simulations. However, the technology is hampered by limited workplace placements, inconsistent employer engagement, and stagnant curriculum revisions (Thomann et al., 2024; Nurlaela et al., 2025;Bacca et al., 2018).

Findings based on RQ4 on contextual barriers that affect the use of VR/AR in VET system. The results show that the application of devices in real VET environments such as workshops is a challenge, because AR is hard to use at the workplace (Candido et al., 2023). Furthermore, the study reveals that human effects like users' report feeling dizzy (Rafiq et al., 2022) is a barrier to effective VR/AR use. The results also indicate that novelty of the technology is an obstacle to learning, as some of the users noted that they should be pre-trained on both the tool itself and what it teaches (Ismara et al., 2024). Additionally, educators have a fear that the extensive use of AR guidance will destroy the basic hands-on skills (Candido et al., 2023).

4. Discussion

This systematic review has compiled global evidences on the use of VR and AR in VET with special reference to implications in Tanzania. The following discussion contextualizes the findings in non-specific contexts of the overall academic and policy discourse, points out thematic implications and discusses the relevance of the international experiences to the unique VET environment in Tanzania.

4.1. International Implementations of VR and AR in VET

The data shows that the introduction of immersive technologies into various VET occupations has significantly increased in the construction, engineering, hospitality, healthcare, and automotive trades. This pattern can be attributed to the larger digital revolution of education under industry 4.0 which considers VR and AR not only as supplementary tools but also as disruptive pedagogical tools. In developed and developing economies, the technologies are being used to recreate high risk, high cost, or logistically constrained training conditions such as electrical fault diagnosis, surgical and heavy machinery operation to simulate these conditions in a conventional workshop environment (Keller et al., 2025;Long et al., 2025). Moreover, there is evidence of the use of AR Dewi et al. (2025) in the culinary arts, Kim et al. (2020) in designing garden, (Lee & Hsu (2021) in cosmetology, Lee (2023) in woodworking and Tian & Tian (2025) in music occupations whereby step by step instructions help in the learning of processes through superimposed technologies. Such examples suggest a universal recognition of VR and AR as supportive of traditional workshop training, especially in the absence of, or in the presence of costly, dangerous or limited physical training resources. The strong spread of the VR and AR applications in the diverse fields of study highlights the growing trend of competency based and experiential approaches to learning, which value mastery of skills over theoretical memorization.

4.2. Enhancement of Skills, Competency Based Learning, and Employability

In all the reviewed literature, there is a positive effect of VR and AR on the ability to acquire skills, engage with learners, and perform the procedure with precision. Situated learning through immersive environment enables trainees to work on tasks through contextual and interactive simulations that replicate real world processes. Researches show increase in psychomotor skills and the work with equipment in case of practice guided by AR cues, or VR simulations (Wulansari et al., 2024;Sirakaya & Cakmak, 2018). Furthermore, the enhanced presence and agency of virtual worlds add to the presence and emotional investment, which are related to the maintenance of learning and retention of skills (Keller et al., 2025;Chiang et al., 2025). These results support the hypothesis that theoretical ability of the immersive technologies improve the control of cognitive loads, spatial reasoning, and procedural memory through the repetitive and feedback-based practice.

4.3. Bridging Skills Mismatches Between Training Institutions and Industry Needs

The main theme that was revealed in the course of the review is VR and AR minimize the skills gaps between the results of VET training and industry requirements. Immersive technologies introduce modern occupational practices that are not reflected in the outdated training curricula by introducing the learners into modern industry approved tools, workflows, and safety measures through training modules (Lee, 2023). For example, VR guided tours of automated factory systems or intelligent grid systems to introduce a person to the technologies of industry 4.0, thus, reducing the exposure gap between VET establishments and the current workplace (Efendi et al., 2025). Moreover, Keller et al. (2025) report that VR inspection simulations allows students to capture real life, complex, and diagnostic work which is far more relevant to work than what is offered in classroom work. This type of learning enables students to perform procedures that are more complex, dangerous, or expensive and would otherwise, inaccessible (Muslim et al., 2024). Although VR and AR are capable of eliminating technical and procedural skill gaps, the ability to overcome systemic misalignments, including low industry-institutional connections, slow curriculum renewal, or insufficient trainer capacity, is low (Ismara et al., 2024;Thomann et al., 2024). Therefore, complementary institutional reforms and collaboration of the stakeholders are the key in effectual integration.

4.4. Contextual Factors Influencing Adoption and Effectiveness in VET

The global factors are transferable to other contexts including Tanzania through a number of contextual constraints which are eminent in Indonesia, Palestine and other emerging economies. The literatures analyzed have international scope, but there are several contextual elements which can be projected as important in Tanzania's adoption pathway. First, the infrastructural readiness, including reliable electricity, internet connectivity, and functioning computer laboratories, are the fundamental components of successful VR and AR integration (Candido et al., 2023;Ortega-Gras et al., 2023). Many immersive technologies necessitate the use of high-performance devices. Restrictions in hardware investment may be more pronounced in developing countries as compared to the environments in which the studies reviewed were undertaken. Instructor digital competence is a second critical factor of success. Studies like Chiang et al. (2025) underline that effective VR instruction is highly dependent on the confidence level and the teacher's pedagogy of immersive contrivances, a skill set that is likely to differ drastically in Tanzania's VET trainers. Third, the scope and sequence of a curriculum, like Tanzanian VET, which are competency-based but highly inflexible in the assessment framework, rigid parameters inhibit the integration of simulation data or VR-based performance evaluation. Institute-industry collaboration has been shown to positively correlate with the effectiveness of a technology through the alignment with industry-defined competencies (Efendi et al., 2025). For Tanzania, the lack of institutional–industry integration and collaboration determine ineffectiveness of immersive tools in addressing the labor market requirements. Cost, and policy are the parameters which may determine the continuation of the process. Fragmented, large scale, and VR and AR integration may remain unsupported when the regulatory frameworks and funding mechanisms are absent.

4.5. Implications for Tanzanian VET

The combination of the VR, AR and MR technologies under the umbrella of extended reality is an opportunity to the VET system in Tanzania to overcome the longstanding skills mismatch between VET output and the labor market requirements. Based on the global experiences on the same issue that the literature sources presented on the topic reveal, certain conclusions regarding the enacting and active use of policies in the Tanzanian setting may be drawn. Such consequences will have to be manipulated taking into account both the proven affordances of the immersive technologies as well as the barriers to their successful implementation that are reported.

Immersive technologies provide a feasible way of beating the resource and infrastructural bottlenecks that have become endemic in limiting practical skill acquisition in Tanzanian VET institutions. According to the included studies of this review, immersive simulations may decrease reliance on physical consumables, costly equipment, and dedicated workshop area bottlenecks in resource constrained environments. For example, VR uses in welding and painting simulation devices have been capable of providing entry level competency training, but with 68% material savings and less waste of consumables (Papakostas et al., 2021;Ajith Benson et al., 2016). This applies to Tanzania where hands-on practice is limited by high prices of equipment and materials. A policy change of strategic movement towards investing in simulation workshops (laboratories) will be a way of democratizing high quality practice training in both urban and rural institutions and directly responding to equity issues. Moreover, as was shown in hairdressing and electrical safety training, inexpensive cardboard VR with smartphones were used to offer immersion experiences without having prohibitively high prices, and scalability is financially feasible (Chiang et al., 2025;Ismara et al., 2024). The Tanzanian policy can focus on mobile-AR and cost-effective VR devices to make sure that wide based access is achieved before it can be raised up to a higher fidelity system.

Pedagogical integration of immersive technologies should be based on evidence-based models that can guarantee transfer of learning, as opposed to using technological innovation solely as a motivation to do so. Literature warned that immersion does not necessarily imply effective learning; in certain instances, traditional practices proved to be superior in comparison with VR in declarative knowledge acquisition (Thomann et al., 2024). In Tanzanian practice, this would mean that XR needs to be incorporated into the reforms of the curriculum on strong teaching systems. The successful models reported are Project-based Augmented Reality and AR-integrated cooperative learning that frame and organize technology application based on collaborative problem solving and reported large effect sizes (d=2.59) on learning (Muslim et al., 2024;Purnomo et al., 2025). The policy will require creation of contextually adjusted digital pedagogy models to be used at teacher training colleges so that teachers can be able to craft lessons in which XR is used to scaffold and provide real time feedback that enhances understanding and not as an engagement tool (Bacca et al., 2018). This will necessitate the relocation of equipment provision to holistic professional development initiatives that foster capacity in the blend of XR with the initial instruction (Yang et al., 2023).

Tanzanian VET institutes may conduct a pilot in using immersive technologies in priority skill sectors like agriculture, construction, transportation, engineering and tourism. For instance, the prototypes of creating localized content, like agricultural machinery maintenance, which is a gap in skills, are presented in AR systems of tractor mechanics and electrical board assembly (Tuwoso et al., 2021;Nurlaela et al., 2025). Similarly, the VR logistics in warehouses and fault diagnosis in power systems as reported by Thomann et al. (2024) and Smith et al. (2021) offer models of training in supply chain management and maintenance of power systems infrastructure. The AR direction decreased the time to proficiency in running equipment and the quicker speed and precision of the novices with MR direction was higher in comparison with that of the specialists (Smith et al., 2021;Lester & Hofmann, 2020). Tanzanian policy must embark on establishing public-private partnership to co-create localized XR content in accordance to national skills interests which could be a Digital VET Innovation Fund to incentivize industry and software creators to produce simulations of high demand jobs. However, immersive technology implementation may pose a risk of creating digital inequalities. Unstable electricity, financial constraints (access and affordability of the internet) and digital illiteracy of students and teachers are some of the barriers. XR must therefore be part of a wider digital inclusion policy, which guarantees infrastructure preparedness. Furthermore, the issue of deskilling phobia observed among teachers as Candido et al. (2023) demonstrate a cultural issue namely, the possible attitude toward simulation as a tool that diminishes genuine mastery. The Tanzanian implementation would therefore need to define XR as an addition to existing hands-on apprenticeship, not as a replacement, which may be formalized by making the virtual practice a requirement to the actual work in competency-based curricula.

Systemic enablers that are required in sustainable integration are coherent policy, localized research, and sustainable financing models. An ecosystem that is facilitating will not succeed in the absence of a standalone technology initiative. The Tanzanian VET policy must determine a national XR in VET policy, standards of content development, teacher competency models and protocols of virtual skills acquisition evaluation. According to the literature, perceived learning in immersive setting is a weak predictor of the true competency, which requires development of novel validation processes (Thomann et al., 2024). Meanwhile, the local Research and Development should be invested in to adjust the technologies in the Tanzanian context and test their effectiveness without taking the imported models blindly. Funding schemes might combine state funding with taxes to beneficiaries in the industry, as savings in the corporations have been recorded in terms of training and waste reduction (Papakostas et al., 2021).

Based on insights from Tanzania’s context and global VET trends and practices, this review gives several recommendations. First, there should be equitable investments in the digital infrastructure to guarantee access to VR and AR learning technologies in VET institutions, especially for the remote, rural VET institutes. Second, policies should foster the provision of targeted professional training to teachers’ instructional skills in VR and AR pedagogy, in step with the success factors proposed in (Chiang et al., 2025). Third, public-private collaborative models should foster and nurture industry advisory collaborations to ensure the alignment of immersive content with labor market skills, a system prominently training in the industry 4.0 ecosystem (Efendi et al., 2025). Fourth, it needs carefully designed frameworks, such as the VR inspection systems on which Keller et al., (2025) focus, should be pilot tested to demonstrate their VR systems designed to Tanzanian industrial conditions. Fifth, policies should support the development of open VR and AR educational resources to lessen the reliance on expensive proprietary materials. Finally, within the VET system, there is a need to frame the policy which integrates mechanistic principles to control rule governance on safety, data privacy, reasonable access, and automated remote assessment for data-driven boundless teaching and learning across VET institutions.

4.6. Limitations of the study

This study experienced three specific challenges. First, the omission of French-language studies which, in combination with the exclusion of non-English literature, resulted in greater language bias. Second is publication bias may also pose challenges; Radianti et al. (2020) explain how studies in VR and AR research tend to underreport neutral or negative findings, which may lead to the biasing of one’s literature review. Third, included studies were conducted in countries with different economic and educational systems, which create contextual heterogeneity that may limit the degree to which findings may be generalized to Tanzania. However, in this case, the limitations were reasonably addressed through thematic analysis and contextual understanding.

5. Conclusion

This review has brought together evidences around the world on the use of VR and AR in VET and has analyzed the implications for its integration in Tanzania. The results show that the use of immersive technologies has expanded rapidly in various VET sectors like technical, industrial, and service-oriented training. The use of VR and AR technologies has been instrumental in providing exposure to inaccessible complex, dangerous, or expensive tasks through experiential learning. The literature shows that from the learner's perspective, immersive technologies help in the acquisition of VET skills, enhanced engagement, and primary mastery of tasks. VR and AR technologies assist in training by offering opportunities for practice, feedback, and situated learning aligned to workplace procedures, thereby improving employability. There is also evidence that these technologies help to overcome skills mismatches by providing learners access to the latest tools and processes within the industry that are often absent in training institutions.

Notwithstanding these points, the extent to which the benefits could be realized in Tanzania depends on different contextual dynamics. Ineffective utilization of digital technology in teaching and learning, barriers to the digital educational devices, and the degree to which the curriculum and instructional materials can be incorporated flexibly adapted present formidable challenges to digital VET. By contrast, the Tanzanian VET system, the digital shift to the 4th industrial revolution, and its growing interest offer unique integration possibilities. Adoption of such benefits realization strategies will require defined policies and systematic considerations on investment in infrastructure, guided the professional development of the teaching practitioners, industry engagements, training immersive learning tools, and their implementation. For the future research, we recommend thorough research to be done in this field using longitudinal approach. Furthermore, a meta-analytical methodology be used in subsequent systematic studies. In addition, most of the included papers for this review used experimental research approach as presented in figure 6. Therefore, in-depth qualitative studies are required in order to get better understanding of immersive technologies in VET especially in low economic African countries like Tanzania.

Disclosure Statement

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