

Review Report



Evaluating the Effectiveness of Personalized Learning Approaches in TVET Colleges

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Abstract: This review examines how personalized learning strategies affect Technical and Vocational Education and Training (TVET) colleges. Personalized learning is an adaptive instructional model that tailors educational experiences to meet the unique needs of each student. It has garnered significant attention for its potential to address the varied learning profiles of TVET learners. The review carefully evaluates existing literature to pinpoint key strategies, challenges, and outcomes related to personalized learning within the TVET context. A thorough methodology is employed to analyze peer-reviewed articles, conference proceedings, and pertinent grey literature from the past decade. Key areas of focus include the impact of personalized learning on student engagement, skill development, academic success, and job readiness. Furthermore, the review investigates the technological tools and teaching frameworks that facilitate personalized learning in TVET settings, while also considering obstacles such as limited resources, teacher preparedness, and policy issues. Initial findings indicate that personalized learning methods can boost student motivation, enhance learning results, and promote career readiness among a diverse group of TVET students. Nonetheless, the evidence is still scattered, highlighting the urgent need for more research on effective and sustainable implementation strategies. The primary goal of this review is to lay the groundwork for future studies.

Keywords: Artificial intelligence; Augmented reality; Personalized learning; TVET; Virtual reality

1. Introduction

The ever-changing landscape of education highlights the importance of tailoring learning experiences to meet the diverse needs of students, a subject that has garnered considerable focus in both academic and policy discussions. This customization is particularly crucial in Technical and Vocational Education and Training (TVET) colleges, where students often come from various educational backgrounds, have different skill levels, and pursue unique career aspirations (Selane & Odeku, 2024). TVET institutions play a key role in preparing students for specific trades and vocational paths, necessitating a flexible and responsive educational strategy. Personalized learning, which adapts educational content, pace, and methods to suit the individual preferences and needs of learners, offers a promising approach to addressing these challenges (Shemshack & Spector, 2021).

Personalized learning (PL) is an established concept that has recently gained wide recognition, primarily due to advancements in educational technology and a growing awareness of its potential to meet the varied needs of learners. Unlike traditional teaching methods that apply a standard approach, personalized learning emphasizes customized educational experiences, enabling students to progress at their own pace, based on their individual strengths and preferences (Indah Susanti et al., 2023). This approach is particularly relevant in Technical and Vocational Education and Training institutions, where students are preparing for specialized careers that require a mix of technical skills, critical thinking, and adaptability. By adopting personalized learning strategies, educators can effectively address comprehension gaps, enhance skill development, and ensure that educational outcomes meet industry requirements. TVET colleges play a crucial role in the education system by focusing on providing practical skills and knowledge that are directly relevant to the job market. Unlike conventional academic routes, TVET programs are designed to serve a wide array of learners, including those who are looking for alternative educational paths and individuals aiming to reskill or upskill for new job opportunities (Zedan, 2021). This variety necessitates a teaching approach that goes beyond standard curricula, emphasizing the individual strengths, weaknesses, and goals of each student. Unfortunately, traditional teaching methods in TVET often fail to address this diversity, resulting in disengagement among students, inconsistent educational outcomes, and a gap between the skills learned and the industry's expectations.

The adoption of personalized learning in TVET colleges represents a major change in educational practices, allowing educators to customize their teaching methods to better suit the unique needs of their students. By focusing on student-centered approaches, TVET institutions can greatly boost student engagement, improve retention rates, and help students develop essential employability skills (Shemshack & Spector, 2021). Personalized learning aligns with global educational trends that highlight the significance of lifelong learning and adaptability in response to the fast-changing job market (Hallová et al., 2017). These aspects make personalized learning a powerful strategy for tackling the challenges faced in TVET education. It is noteworthy that technology plays a crucial role in facilitating personalized learning, providing educators with the tools and platforms needed to create and deliver tailored educational experiences. Innovations like learning management systems (LMS), adaptive learning software, and data analytics have transformed personalized learning in TVET

settings (Alserhan & Yahaya, 2021). These technologies allow educators to monitor student progress, pinpoint areas needing improvement, and offer targeted support, thereby creating a more engaging and interactive learning environment.

In technical and vocational education and training institutions, incorporating technology-enhanced personalized learning has shown great promise in bridging the gap between theory and practice. The use of virtual reality (VR) and augmented reality (AR) is on the rise (See Figure 1), enabling the simulation of real-world scenarios and providing students with hands-on learning experiences in a safe and controlled environment (Vats & Joshi, 2024). Furthermore, artificial intelligence (AI) and machine learning can analyze student performance data to recommend customized educational paths, ensuring that each learner gets the support they need to succeed academically. These technological innovations not only enhance the learning experience but also prepare students for the increasingly digital workplaces of the future.



Figure 1: Image of Virtual Reality vs Augmented Reality

Personalized learning is an innovative framework aimed at meeting the diverse needs of students in Technical and Vocational Education and Training colleges. By customizing educational pathways for each learner, this approach has the potential to enhance student engagement, improve academic outcomes, and prepare students for the workforce. However, the successful implementation of personalized learning in TVET settings is challenged by various issues, such as limited resources, the readiness of educators, and policy constraints. This review aims to provide a thorough analysis of personalized learning in TVET education, setting the foundation for future research and guiding the development of effective and sustainable strategies for implementation.

1.1. Statement of Problem

The diverse educational backgrounds of students enrolled in Technical and Vocational Education and Training colleges create significant challenges for the effectiveness of traditional, standardized

teaching methods. Many students struggle to engage with the curriculum, develop necessary skills, and meet the expectations for academic success and job readiness. This is primarily due to the lack of tailored educational interventions. Personalized learning, which adapts teaching methods to fit individual student needs, has the potential to address these challenges (Shemshack & Spector, 2021). However, there is a notable lack of substantial evidence regarding its implementation, effectiveness, and scalability in TVET settings. This gap in knowledge underscores the need for a comprehensive evaluation to determine the effectiveness of personalized learning approaches in promoting student engagement, skill enhancement, and career readiness within TVET institutions.

1.2. Purpose of the Review

The general purpose of this review article is to undertake the following studies:

- (a) To examine how personalized learning methods impact TVET institutions.
- (b) To evaluate the strategies for implementing personalized learning in TVET colleges.
- (c) To analyze the role of technology in enhancing personalized learning for TVET students.
- (d) To identify the challenges in implementing personalized learning practices in TVET colleges

1.3. Review Questions

The following review questions guided the study:

- (a) What are the impacts of personalized learning practices on TVET students?
- (b) What are the personalized learning approaches adopted in TVET colleges?
- (c) What are the challenges of implementation of personalized learning in TVET colleges?
- (d) What are the strategies for solving the challenges of implementation of PL in TVET colleges?
- (e) What are the roles of technology in personalized learning of TVET students?

2. Materials and Methods

2.1. Design for the Study

The design approach used in this study is scoping review. The scoping review is a research method that explores the broad range of evidence related to a specific topic. It carefully outlines key concepts, highlights gaps in current knowledge, and clarifies relevant research questions. This type of review offers a comprehensive summary of existing studies, utilizing various sources to inform future research efforts, guide policy decisions, and improve practice, without assessing the quality of the studies included.

2.1.1. Ethics Statement

The review thoroughly analyzes publicly available literature, ensuring that there is no involvement of personal data or violations of ethical standards during the review process. This study recognizes and addresses the gaps in the literature on personalized learning, offering practical suggestions to improve personalized teaching and learning methods in TVET colleges.

2.2. Eligibility criteria

Search for the research was conducted in various databases, including Scopus, Google scholar, DOAJ. Eligibility criteria included peer-reviewed published articles, conference proceedings and book chapters which focused on personalized learning in technical and vocational education and training (TVET). Thereafter, those that did not meet those selection criteria were discarded as

summarized in Figure 2.

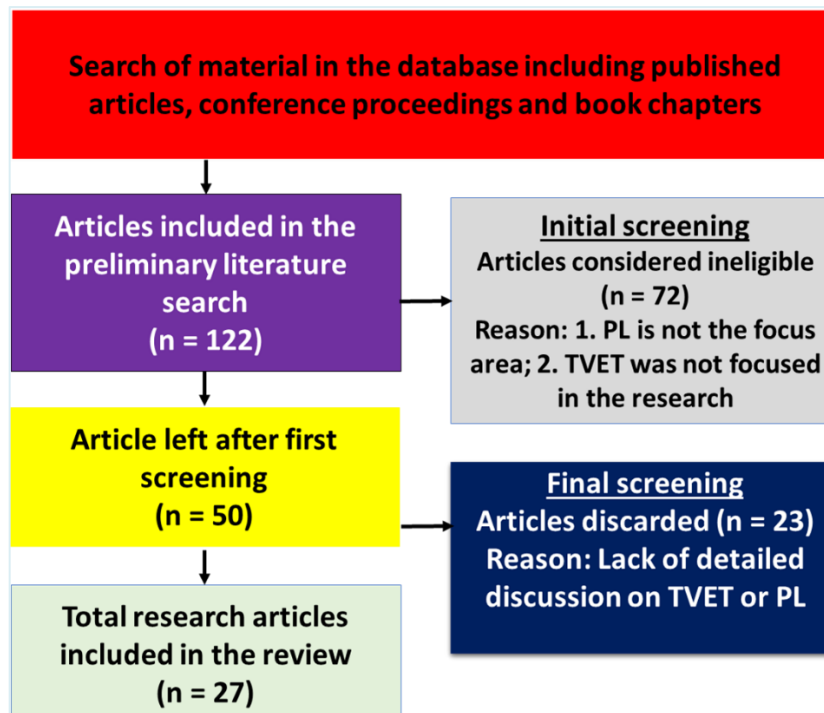


Figure 2: Prismatic Diagram of Selection Criteria of Reviewed Literature

3. Results and Discussion

3.1. Impacts of Personalized Learning Approach on TVET Students

Personalized learning plays a crucial role in enhancing learner engagement within TVET institutions by customizing educational materials to fit the specific interests, career aspirations, and skill levels of individual students. This method encourages active involvement, boosts motivation, and stimulates curiosity by aligning practical tasks with the unique strengths of learners. As a result, this increased engagement leads to a more profound understanding, improved hands-on experiences, and a stronger connection to real-world applications. The progress of skill development in TVET institutions through personalized learning focuses on the unique paces and styles of each learner. This approach enables effective mastery of technical skills by providing tailored feedback, ensuring proficiency in practical abilities that are in demand in today's job market. Enhanced educational outcomes in TVET institutions are achieved by implementing personalized learning that caters to the unique needs of each learner. This method enables students to master concepts at their own pace and provides customized support, greatly improving both academic performance and practical skills. Figure 3 shows various learning tools that can be introduced to TVET colleges through personalized learning framework. The use of technology in TVET institutions, especially through personalized learning methods, greatly enhances educational results. By utilizing AI-driven platforms, simulations, and virtual labs, these resources meet the individual needs of each student. This approach encourages self-directed learning, delivers instant feedback, and provides hands-on experience. Technology expands access to training opportunities, tackles current skill gaps, and ensures that educational programs are tailored to the specific demands of different industries.

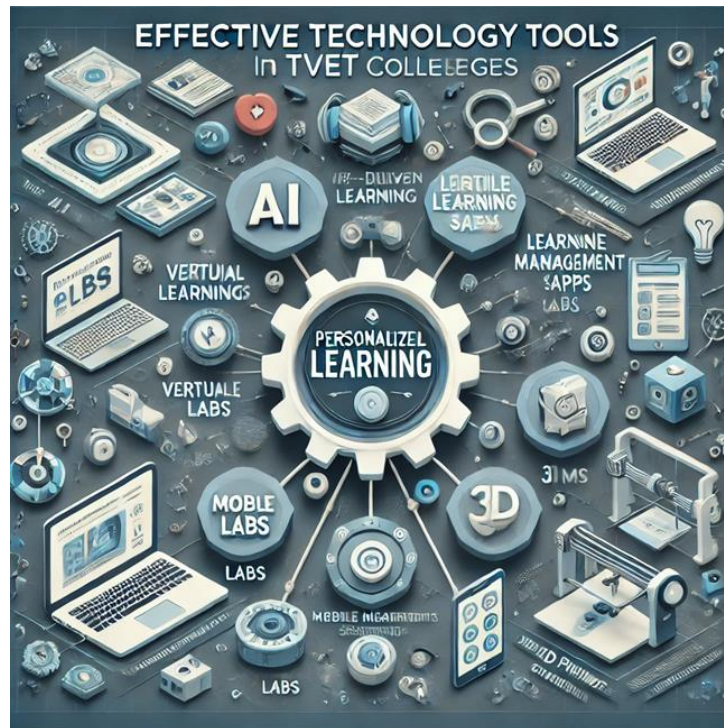


Figure 3: Effective Personalized Learning Tools

The implementation of personalized learning approach in TVET colleges greatly reduces dropout rates by addressing individual challenges, providing tailored support, and creating engaging, adaptable learning environments. This approach not only enhances student confidence but also helps maintain their motivation and dedication to their studies. Personalized learning in TVET colleges is essential for fostering soft skills by providing activities tailored to the unique needs of students. These activities emphasize important areas like teamwork, communication, problem-solving, and adaptability, all of which are relevant to real-world job scenarios. Furthermore, using interactive and student-centered approaches, such as role-playing, simulations, and reflective practices, promotes active engagement and improves self-awareness, ultimately strengthening vital interpersonal skills. Personalized learning aims to address industry needs by tailoring educational programs to focus on the skills and competencies that are in high demand in the job market. This method enables students to select specific pathways and specializations that resonate with their career goals, while also incorporating tools, technologies, and practices relevant to their fields. Partnerships with industry stakeholders further improve the training's relevance, preparing learners for a smooth transition into the workforce. Personalized learning improves accessibility by leveraging technology and flexible approaches to meet the diverse needs of learners. Adaptive tools adjust content based on individual abilities, supporting those with disabilities or language barriers. Additionally, mobile learning apps and online platforms expand access for students in remote or underserved regions, offering flexible schedules and equal opportunities for skill development.

3.2. Personalized Learning Approaches (PLA) in TVET Colleges

Table 1: Personalized Learning Approaches Adopted in TVET Colleges

PLA	Annotations	Significance	Challenges	Ref.
Competency-based	Involves proficiency in specific skills which aligns with identified industry standards or job requirements.	Equips students for the job market by focusing on the development of relevant and practical skills. Promotes self-learning and responsibility.	Resource-demanding, qualified educator required, overdemanding measurable skills and inconsistent industry demands.	(Shems hack & Spector, 2021)
Blended learning	A blend of traditional classroom teaching with digital resources and self-directed modules. Online tools used to customize learning based on personal needs	Promotes self-learning, improves learning accessibility and flexibility, encourages lifelong learning, support learning scalability	Initial cost- and time-intensive, lack of access to internet, electricity and devices, requires digital skill, misalignment of classroom with online contents	(Owston, 2018)
Specified learning plans	Individualized roadmaps designed for each student, with specific objectives, necessary skills, and learning paths. The plans match the students' career aspirations and the industry needs	Creates better educator-learner bond, enhances career skills, provides real-time evaluation of progress, explicit goals set.	Dearth of scalability, danger of isolated learning, lack of variety of qualified specialized teachers, resistance from stakeholders.	(Britton & Spencer, 2020)
Adaptive learning technology	Artificial intelligence-based approach that gets feedback on the progress of the learner. Includes interactive simulations and virtual labs that support different skill levels	Real-time feedback, high scalability, cost & time effective, personalized learning, increased student engagement	Over concentration to data may lead to knowledge in only quantitative and not qualitative aspects, widens digital divide due to inequality in accessibility, this may hamper creativity	(Tyagi et al., 2024)
Project-based learning	Learning tailored on career	Promotes collaboration, high knack for problem	Time and resource-consuming, restricted	(Shpeizer, 2021)

	objectives, interest and real-world project.	solving, enhances hands-on experience	knowledge, lack of scalability, uncertainty of results	2019)
Mentoring and instructing	Specialized coaching from qualified educators and industry personnel. Focus is on specific skills and practical activities.	Emotional care, leadership empowering, restores confidence on learners, skill empowerment.	No feedback, time & resource intensive, no formal plan, there may be bias and incompatibility, lacks adequate training, overdependence to the mentor.	(Nigate et al., 2023)
Flexible learning models	Based on individual-pace for learning. There is an option for part-time courses for working class. Bridges the population learning gap.	Highly accessible and inclusive learning, aligns with up-to-date technology, increased independence and responsibility, creates room for creativity.	No structural plan, lacks discipline, cost intensive, no progress monitoring, poor practical learning opportunity.	(Detyna & Domme tt, 2024)
Micro-credentials and certification pathways	Focused on obtaining certificates on specified skills and learning areas. Learners can amass certificates to grow interesting expertise continuously	Equity in learning, combines education and work, wide recognition, personalization, learning aligned to industry need, cost effective.	Over emphasis on self-responsibility, likely to misalign with industry needs, mostly focused on hard skills, there may occur low return-on-investment	(Varada rajan et al., 2023)
Gamification	Games in the form of exercise, challenges are introduced into the learning curricular. It makes the learning and skill acquisition fun filled.	Improved learning through motivation and engagement, higher retention, real-time feedback, increased innovation and productivity, improved resilience.	Cost & resource intensive, overdependence on quantitative data, possibility of manipulation, overdependence on external rewards like points, badges.	(Al-Msalla m et al., 2023)
E-portfolios	Documenting progress and achievement in digital format. Learners take	Displays skills and progress, gives motivation, promotes collaboration and real-time feedback,	Time intensive to create, high skill needed, overemphasis on outward appearance than content, lacks standards,	(Smith, 2018)

control of their education, for tailored experiences.	accessible and portable, improves confidence, digital literacy	publicizing self-information, promotes offline use, risk of being plagiarized.	private lack of being
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Table 1 shows different PLA in TVET colleges and their strengths and weaknesses.

3.3 Challenges for the Implementation of Personalized Learning in TVET Colleges

The implementation of personalized learning (PL) in Technical and Vocational Education and Training colleges faces significant challenges due to limited resources. These challenges include insufficient funding, outdated equipment, and limited access to technology (Ujah, 2023). Such shortcomings restrict the ability to provide tailored learning experiences, obtain modern tools, or properly train educators. The financial difficulties encountered by students worsen existing disparities, reducing the inclusivity and overall effectiveness of PL initiatives. In TVET colleges, the issue of large class sizes greatly impedes the implementation of personalized learning approaches. Educators, limited by time and resources, often struggle to give individual attention, evaluate each student's progress, and modify their teaching methods to meet the specific needs of every learner. As a result, Campaña-Jiménez et al. (2019) opined that this typically results in a one-size-fits-all teaching model that undermines the core tenets of personalized learning, ultimately reducing student engagement and educational success. One of the major obstacles to personalized learning in TVET colleges is the insufficient training of teachers. Many educators are not equipped to design and implement effective PL strategies due to a lack of necessary skills. This challenge is made worse by a scarcity of professional development opportunities and a limited understanding of digital tools. Resistance to change and the demands of heavier workloads result in a lower willingness and ability among teachers to adopt innovative, learner-centered practices. A significant obstacle to implementing personalized learning in TVET colleges is also the inflexible nature of the curriculum. The presence of rigid curricula and uniform evaluation methods greatly hinders the ability to tailor education to meet the varied needs of students. This lack of flexibility makes it difficult to modify pacing, choose appropriate content, and use different teaching strategies, ultimately making it harder to align educational paths with the unique goals, interests, and industry demands of students.

The challenge of addressing the varied needs of students has a major impact on the success of personalized learning in TVET colleges. Students generally present a broad spectrum of educational backgrounds, learning preferences, and professional goals. To effectively manage these differences, it is important to implement targeted instructional strategies, which often necessitate significant resources and a considerable investment of time. Challenges like language barriers, disabilities, and differing skill levels further complicate the creation of inclusive and effective learning environments. One major challenge to the effective implementation of personalized learning in TVET colleges is the inadequate integration of technology. The lack of sufficient digital infrastructure, such as learning management systems (LMS), modern software, and stable internet access, restricts the use of personalized learning tools (Alserhan & Yahaya, 2021). If educators lack technological skills, it can further impede the customization of learning experiences, making it difficult to achieve fair and

effective educational outcomes. Institutional and policy issues: Institutional and policy barriers also pose serious challenges to the successful implementation of personalized learning in TVET colleges. The inflexibility of administrative systems and the dominance of standardized policies frequently obstruct the adaptability that PL requires. Insufficient backing from institutional leadership, outdated accreditation standards, and a misalignment between the institution's objectives and those of PL further complicate the adoption process, stifling both innovation and the advancement of learner-centered approaches. The challenge of balancing practical and theoretical learning is especially evident in the realm of personalized learning at TVET colleges. Practical skills often require group-based, standardized training that depends on shared resources, limiting opportunities for individualized learning experiences. On the other hand, theoretical knowledge can be more readily customized to fit individual needs, but it risks becoming disconnected from practical application. (Qu et al., 2023), therefore, remarked that achieving a harmonious relationship between personalized theoretical education and practical training that aligns with industry standards is a complex task.

3.4. Strategies to Address the Challenges of Implementing PL in TVET Colleges

The training of teachers is a key strategy for overcoming the challenges associated with personalized learning in TVET colleges. Comprehensive professional development programs are essential for equipping educators with the skills required to design and implement individualized learning experiences effectively (Bloomfield et al., 2024). This training should focus on the use of digital technologies, adapting curricula to accommodate a diverse student population, and promoting learner autonomy. By engaging in workshops, receiving mentorship, and accessing ongoing support, teachers can evolve from traditional teaching methods to more innovative, learner-centered approaches. Moreover, training in data-driven instructional practices enables educators to track student progress and refine their teaching strategies as needed. Skilled and empowered teachers are vital for addressing the challenges of PL and ensuring its successful implementation.

The integration of technology into the PL system is a vital approach to addressing the challenges of implementing PL in TVET colleges. Building a strong digital infrastructure, including learning management systems (LMS), is crucial for granting access to customized resources and adaptive learning solutions. By providing students with modern tools and software, institutions equip them to engage in practical training that aligns with the needs of the industry. Furthermore, enhancing educators' skills in using digital platforms and tools significantly improves their ability to create and deliver personalized learning experiences. The use of data analytics systems facilitates the monitoring of individual student progress, which is essential for making necessary adjustments to meet diverse learning needs. Ensuring reliable internet access and the availability of accessible technology promotes inclusivity (Brooks et al., 2020), effectively bridging the digital divide and enhancing the overall success of personalized learning efforts.

Implementing a flexible curriculum is vital for overcoming the challenges related to PL in TVET colleges. Such a curriculum allows for necessary customization to address the diverse needs, learning styles, and career goals of students. Flexibility in the curriculum enables adjustments in the pace of

learning, the methods of content delivery, and the assessment processes, ensuring they synchronize with individual progress and industry demands (Barua & Lockee, 2024). By adopting modular frameworks and competency-based approaches, learners can focus on critical skills while also pursuing their interests. Integrating project-based and experiential learning significantly enhances student engagement and the practical application of knowledge. It is also important to collaborate with industry stakeholders to ensure the curriculum's relevance, while policy reforms aimed at reducing rigidity grant educators more freedom.

The collaboration strategy plays a key role in addressing the challenges of implementing PL in TVET colleges. By partnering with industry stakeholders, educational institutions can create curricula that respond to workforce needs, equipping students with practical skills. Moreover, collaboration among educators encourages the sharing of effective practices, innovative strategies, and instructional resources designed for personalized learning. Involving parents and community members is essential for gaining support for PL initiatives, which contributes to a more inclusive educational environment. Collaborating with technology providers can also enhance access to digital resources and infrastructure (Liu et al., 2024). These collaborative efforts promote interdisciplinary learning, enabling students to draw connections between different fields of knowledge. Ultimately, by harnessing shared expertise and resources, collaboration boosts the effectiveness of PL implementation, leading to improved educational outcomes for students. The implementation of equity measures is crucial for ensuring fair access to personalized learning in TVET colleges, as they aim to address and correct existing disparities. By providing technology, financial assistance, and inclusive educational resources, these measures effectively close the gaps faced by marginalized students. More so, targeted support mechanisms, such as mentorship and counseling, are vital for meeting the diverse needs of learners. These initiatives foster an inclusive educational environment, allowing all students to take advantage of PL opportunities, regardless of their unique circumstances or available resources.

3.5 Roles of Technology in Implementing Personalized Learning in TVET Colleges

Figure 4 shows various technological tools and infrastructure necessary for implementing PL in TVET colleges. The role of technology in implementing PL in TVET colleges will be discussed in this section. The use of automation and artificial intelligence, products of science and technology (ST), in TVET colleges enhances personalized learning. This is done by automating grading and administrative tasks, providing customized educational materials generated by AI, and using adaptive assessment methods. These technological improvements not only boost operational efficiency but also create tailored learning experiences and enable prompt feedback on student performance. Learning management systems (LMS) play a crucial role in providing personalized learning in TVET colleges. These systems bring together educational resources, encourage self-directed learning, and enable educators to customize content to fit the unique needs of each student. LMS platforms track student progress, provide instant feedback, and include a range of multimedia resources, which boosts student engagement (Qazdar et al., 2023). Their accessibility and compatibility with other educational tools greatly enhance both the learning experience and the effectiveness of teaching.

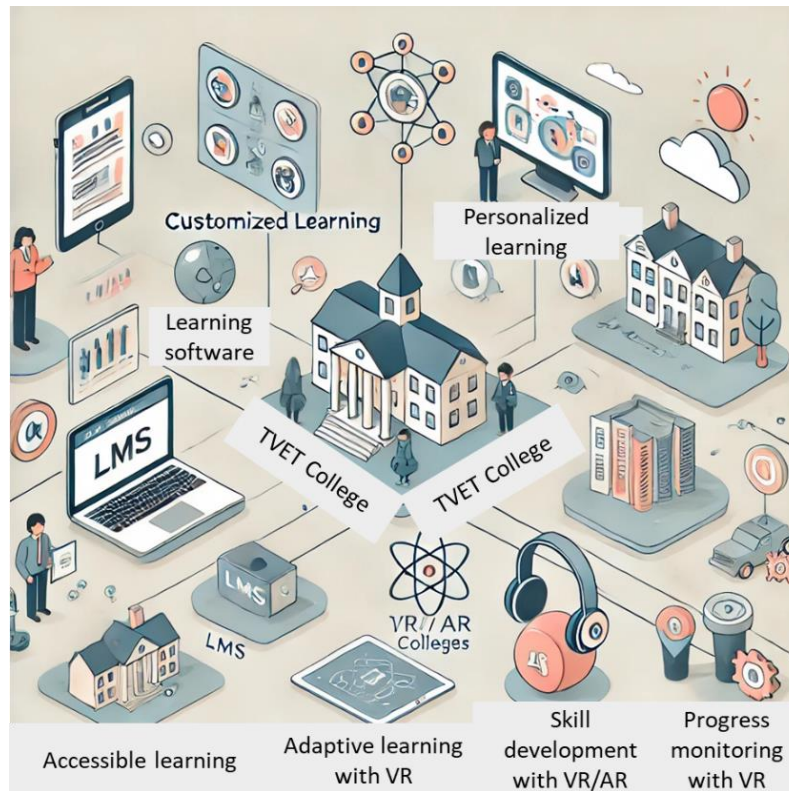


Figure 4: Image of Tools and Infrastructure for PL in TVET Colleges

Virtual and augmented reality (VR/AR) is changing the way personalized learning is approached in TVET colleges by delivering immersive, hands-on training in simulated environments. VR offers a safe platform for students to practice complex skills, while AR adds interactive digital features to real-life scenarios (Chiu & Tsuei, 2022). These technologies enhance skill acquisition, boost engagement, and deepen understanding, providing students with tailored, industry-relevant experiences that effectively link theory with practice. The use of data analytics greatly improves the tracking of progress in personalized learning settings at TVET colleges. By gathering and analyzing student performance data, it identifies areas where students may be struggling, assesses their engagement levels, and provides valuable insights for tailored interventions. As a result, educators can modify their teaching strategies based on real-time analytics, helping each student to effectively achieve their educational objectives.

The role of multimedia resources in personalized learning is vital, as they blend various formats such as videos, animations, interactive simulations, and audio files. These diverse resources address multiple learning styles, like visual, auditory, and kinesthetic, boosting engagement and making the material more accessible. In TVET colleges, multimedia resources help students better understand complex ideas, support practical skill acquisition, and provide flexible, self-paced learning options, enhancing the overall educational experience (Zhou & Yang, 2024). The use of mobile learning is also essential for improving accessibility in personalized education, especially for students in TVET colleges. With smartphones and tablets, learners can access educational materials whenever and wherever they need. This approach encourages flexible and self-directed learning, catering to the diverse needs and schedules of students (Nobre & Moura, 2017). Mobile apps and platforms offer

microlearning opportunities, engaging activities, and instant feedback, enabling learners to study on the go and effectively overcome challenges related to location and resource availability.

4. Conclusion

Personalized learning is a key strategy for meeting the diverse needs of students in Technical and Vocational Education and Training colleges. This approach boosts student engagement, skill development, and academic performance by tailoring educational experiences to the specific strengths, goals, and learning styles of everyone. However, the implementation of personalized learning often faces challenges, including limited resources, insufficient training for teachers, and technological obstacles. To overcome these challenges, it is important to adopt effective strategies, such as improving teacher training, creating flexible curricula, and embracing technological innovations. There is need to create professional training programs that focus on personalized learning methods and the integration of advanced technology tools. It is important to allocate funds for digital resources, Learning Management Systems (LMS), and reliable internet access to support tailored learning experiences. It is suggested to implement modular, competency-based curricula that caters to diverse learning styles and align with industry demands and establish partnerships with business leaders to ensure that educational programs meet the current needs of the workforce. Financial support, accessible technology, and inclusive educational resources are required to address inequalities in learning opportunities. The incorporation of virtual reality, augmented reality, artificial intelligence, and data analytics can help to improve personalized learning experiences and link theoretical knowledge to practical applications.

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Conflict of Interest

There is no conflict of interest whatsoever.

Author Contributions

All work, from conceptualization to the submission of the draft paper, was done solely by COU.

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N/A

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