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MINI REVIEW OF TRENDS, CHALLENGES AND FUTURE DIRECTIONS OF INTEGRATING GAMIFICATION INTO TVET

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Abstract:

This mini-review explores the trends, challenges, and future prospects of gamification use in Technical and Vocational Education and Training (TVET), highlighting its potential to enhance learners' motivation, engagement, and ability to apply skills in their practical learning. The relevant literature was systematically searched in Scopus, ScienceDirect and Google Scholar with specific combinations of keywords: gamification, "TVET", "Vocational education", and "Learning outcomes". In order to preserve the integrity of the research, a strict methodology was used, which only included English peer-reviewed publications and excluded non-English and grey literature. The results demonstrate that the use of gamification is becoming more and more relevant in TVET, as it promotes active learning, collaboration, and retention, while also aligning with the demands of industry 4.0, which require digital and tech skills through tools and gamification elements such as points, badges, leaderboards, and simulations. But not all of this is due to implementation inconsistencies; problems such as lack of infrastructure, lack of teacher preparation, and lack of consistent evaluation practices continue to exist. The sustainability of gamification's motivational power is also being challenged along with its ability to become over-gamified, losing educational value. Also, the sustainability of the motivational power of gamification is being questioned, as well as its ability to become over-gamified, losing educational value. There are gaps in knowledge regarding practical effects on employability and in skill transfer across domains, dimensions, and across cultures. There is an urgent need for further research to create evidence-based frameworks, standardised evaluation tools and scalable models applicable to various vocational contexts.

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Keyword:

Gamification; TVET; Trends; Challenges and Future Directions



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Introduction

The fast-increasing digitalization in education transformed the way knowledge is created, interpreted and applied in the areas of teaching and learning. One of the most impactful innovations is gamification, which utilizes game design elements, such as points, badges, leader boards, and challenges in non-game settings to enhance learner engagement and motivation (Jaftha et al., 2021). In recent years, gamification has garnered increasing attention from various educational fields as a means of making education more interactive, learner-centered, and results-focused in general (Lampropoulos & Sidiropoulos, 2024). Celasun et al. (2024) emphasize that gamification is a disruptive methodology that incorporates gaming elements, such as points, badges, leader boards, and progress bars, into conventional learning environments. Notably, research focusing on the impact of gamification on students' intrinsic motivation and performance has revealed that integrating game elements, such as rewards, achievement levels, and challenges, into learning activities has positive effects (Qudsi, 2024; Dasoo, 2024). As a result, it lowers anxiety while boosting students' confidence, teamwork, and cognitive engagement, making it a useful tool for addressing a range of educational requirements. With its focus on practical skills and competency-based learning, gamification in TVET institutions has been characterized as a promising possibility to establish an enabling atmosphere where learners can be continually engaged and persistent. This leads to improved performance in both traditional and digital learning environments (Omar et al., 2022).

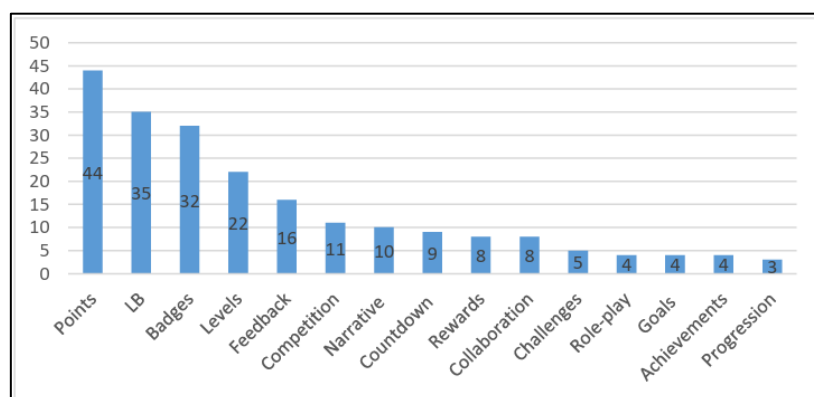


Figure 1: Most Used Gamification Features (Jaftha et al., 2021)

Gamification components and mechanics are essential for improving learning outcomes, motivation, and engagement in the context of education and training (Triantafyllou et al., 2025). Additionally, bibliometric studies show a notable increase in research on gamification as a pedagogical innovation between 2018 and 2025, which reflects global interest in this strategy in connection to the 4.0 Industrial Revolution and 21st-century education (Irwanto et al., 2023; Wijaya & Sobandi, 2025; Haryandi et al., 2024; Fauzi et al., 2025). Although gamification is becoming increasingly popular, its practice and integration into TVET education are inconsistent. It has been discovered that gamification would contribute to increasing the level of student engagement, teamwork, and retention (Smirani & Yamani, 2024; Talentino, 2025; Hanifah et al., 2025), while barriers like inadequate digital infrastructure, limited pedagogical training, and long-term learning impacts are uncertain (Alenezi, 2023). Furthermore, educators and scholars are engaged in an ongoing discussion about the effectiveness and sustainability of gamification in occupational settings, as well as its comparison to other more conventional experiential and workshop-based approaches (Dahalan et al., 2024; Omar et al., 2022; Omar et al., 2023; Zhu Jin et al., 2024). As a consequence, there is a knowledge gap on optimizing gamification to the practical and competency-based nature of TVET curriculum..

Thus, the aim of this mini review is to summarize the current trends, highlight challenges facing academia and practitioners, and present future directions for applying gamification in the field of TVET teaching and learning. It reviews existing literature on the conceptualization and enactment of gamification in vocational education, summarizes contextual aspects influencing its uptake, and examines emerging pedagogical and technological developments. By characterizing the heterogeneity of the existing literature with respect to the pedagogical effectiveness of gamification in vocational education, means to overcome challenges and gaps in research, and identifying key trends, challenges, and future directions, the review provides a thorough overview.

This review provides a reader-friendly introduction, documentation, and overview of the new field of TVET gamification and its current uses. Finally, gamification can revolutionize and improve student engagement, retention and skill development in TVET. To be successful in the long run, evidence-based models and institutions' readiness to accept change, as well as active pedagogical innovations, will be required.

Methods

A literature review was carried out using the databases: Scopus, Science Direct, Google. The relevant articles were collected via the search terms "gamification" OR "game-based" OR "game design" OR "serious games", combined with the search terms "technical education" OR "vocational training" OR "skills training" OR "apprenticeship", with the search terms "engagement" OR "motivation" OR "learning" OR "participation", with the search terms "assessment" OR "evaluation" OR "feedback" OR "performance", with the search terms "curriculum" OR "instruction" OR "pedagogy" OR "learning outcomes". Various article types were considered, including original research articles, systematic review, meta-analysis and case studies, for this mini review.

The following is a list of inclusion and exclusion criteria for the papers included in this review article.

Inclusion Criteria

- Studies that examine the integration of elements in the field of gamification such as badges, points, leaderboards and simulations in TVET and the impact on student engagement, motivation and skill enhancement
- Research on the use of digital tools, and gamified learning technologies in the enhancement of competency-based and practical education in the TVET institutions highlights the capability of these tools to promote interactive learning pedagogies that are learner-centered.
- A study on gamification benefits and challenges in TVET identified that gamified systems have proved to be effective for inducing participation, teamwork and performance; however, there are several challenges associated with the implementation of gamification, including unbalanced instructional design, teachers' lack of readiness, and technological limitations.
- English-language studies also stress the growing trend toward digitalization in vocational education, gaps and inconsistencies, such as the absence of longitudinal studies, cross-cultural validation lack and varied results between fields.

Exclusion Criteria

- Studies published in languages other than English were not included because they were not available and/or not accessible in the same format.
- Studies that addressed TVET without mentioning gamification or its incorporation into teaching and learning procedures were disregarded.
- By concentrating primarily on peer-reviewed and fully published research, grey literature such as conference abstracts, unpublished reports, theses, and papers in press was eliminated in order to maintain the calibre, legitimacy, and dependability of the results.

Results and Discussion

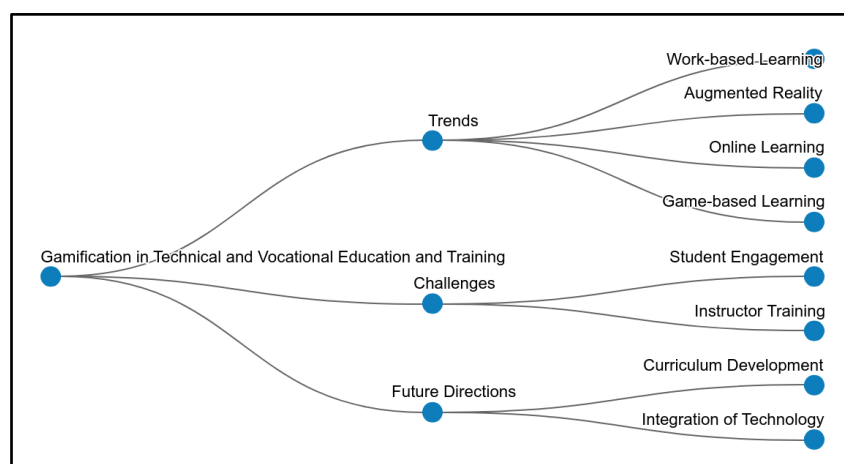


Figure 2: Concept Map generated with Scopus AI for Gamification in TVET

Concept maps and major TVET gamification themes produced by Scopus AI are displayed in Figure 2. Work-based learning, augmented reality, online learning, and game-based methods that boost student motivation are all included in the term "gamification" in TVET. However, ensuring student involvement and preparing teachers to use these techniques effectively present significant obstacles. In the meantime, in order to improve the efficacy of vocational education and training, future directions place a strong emphasis on developing more suitable curricula and integrating technology thoroughly.

Present situation of the integration of gamification in TVET according to Theme Trends

With the goal of improving learner motivation, engagement, and skill mastery through game-based components like points, badges, leaderboards, and simulations, gamification has become increasingly popular in TVET (Samah et al., 2022; Omar et al., 2022; Dahalan et al., 2024; Mohamed, 2024). According to recent advances, there is a growing trend toward digital and immersive learning environments that meet the requirements of Industry 4.0 (Boedy Irhadanto et al., 2024; Oliveira et al., 2023; Zakaria & Mahat, 2024; Zhukova et al., 2023). Higher cooperation, better knowledge retention, and higher learner participation are all advantages of gamification. However, issues like inadequate teacher preparation, uneven instructional design, and inadequate infrastructure continue to exist (Tolentino, 2025; Angco et al., 2025; Wulan et al., 2024; Titania, 2024). Mobile learning apps, virtual and augmented reality, and gamified learning management systems are some of the key technologies propelling these endeavours. However, discussions over how to strike a balance between entertainment and educational value, as well as the absence of standardized models to gauge long-term learning effects, persist (Polat, 2023; Damaševičius et al., 2023; Lee et al., 2025; Xu et al., 2023). Technical abilities and problem-solving skills have been successfully developed through practical applications. But there remains variability in the uptake of the concept across institutions and regions (Gonzalez Almaguer et al., 2022; Salas Rivas et al., 2022; McGowan et al., 2023; Humeniuk, 2023). Research gaps include cross-cultural and longitudinal studies of efficacy in different TVET contexts. From a future perspective, the development of new evidence-based frameworks, teacher capacity development, and access to tools in the form of games should be promoted to be able to connect their potential in developing the digital vocational education.

Current situation of the integration of gamification in TVET in terms of Theme Challenges

Gamification in TVET presents opportunities as well as significant challenges in today's era of education, as described by Amin et al. (2023), Mohamed (2024), Omar et al. (2022), and Samah et al. (2022). As TVET systems evolve to meet the needs of digital businesses, gamification provides a method to enhance learner engagement, motivation, and skill development by incorporating interactive elements such as points, badges, and simulations (Luo, 2024; Samah et al., 2022). However, its potential is limited due to a variety of constraints such as poor infrastructure, low digital literacy of teachers, and the absence of standardized implementation frameworks (Dahalan et al., 2024; Chen & Chan, 2024). To overcome these challenges, key technologies are slowly reshaping TVET landscape, notably, gamified learning management systems, virtual and Augmented Reality, and Mobile learning platforms. The benefits are obvious in terms of increased engagement, teamwork and competency-based learning outcomes. Simultaneously the question of the "balance of superficial rivalry and intrinsic incentive" is still being discussed. The measurements of learning efficacy vary and there are very few studies that focus on the long-term effects (Kode, 2025; Do et al., 2024; Sal-de-Rellán et al., 2025; Gwenhure & Spty Rahayu, 2024). Building on these discoveries, the creation of

inclusive frameworks, teacher preparation programs, and empirical research evaluating long-term educational and professional outcomes should be given top priority in future directions. Therefore, enhancing cooperation among educators, legislators, and technologists can aid in the improvement of gamification techniques, guaranteeing that they significantly contribute to fair, efficient, and future-ready vocational education systems (Jatmoko et al., 2023; Chui et al., 2025; Wahyudin et al., 2025; Ghosh & Ravichandran, 2024).

Current condition of integrating gamification into TVET based on Theme Future Directions

Creating flexible, technology-driven learning environments that meet changing workforce demands is the key to incorporating gamification into TVET in the future (Dahalan et al., 2024). According to recent advancements, there is an increasing usage of digital technologies to provide interactive, skills-based training, such as immersive simulations, virtual and augmented reality, and AI-supported learning systems (Zhou, 2024; Janson et al., 2023; Li et al., 2024). Increased student motivation, engagement, and retention as well as improved teamwork and problem-solving skills are among the advantages of gamification (Bharti, 2023; Amin et al., 2024; Gejandran & Abdullah, 2024; Schöbel et al., 2023). Nonetheless, there are still issues, such as uneven application, inadequate infrastructure, and a dearth of educational frameworks suited to professional settings (Omar et al., 2023; Dahalan et al., 2024; Meylani, 2025; Ghoulam et al., 2024). Although there is no denying that gamified learning improves student motivation, there is still disagreement among academics regarding its long-term effectiveness, implications for equity and accessibility, and adaptability in various institutional and cultural contexts (Li et al., 2024; Kumar et al., 2024; Meylani, 2025; Jose et al., 2024). The available evidence-based models that relate gamification and practical employability are limited, and there is a lack of long-term studies examining the sustainable impact of gamification (Omar et al., 2022; Umbara & Handayani, 2023; Wulansari et al., 2024; Narsico et al., 2024; Ejjami, 2024). Future research should concentrate on increasing educator training, creating uniform evaluation measures, and incorporating gamification into holistic digital learning ecosystems in order to close these gaps. Gamification can fill in these gaps and transform from an incentive to a new pedagogical approach for vocational education in the 21st century which will foster creativity, diversity and skill relevance.

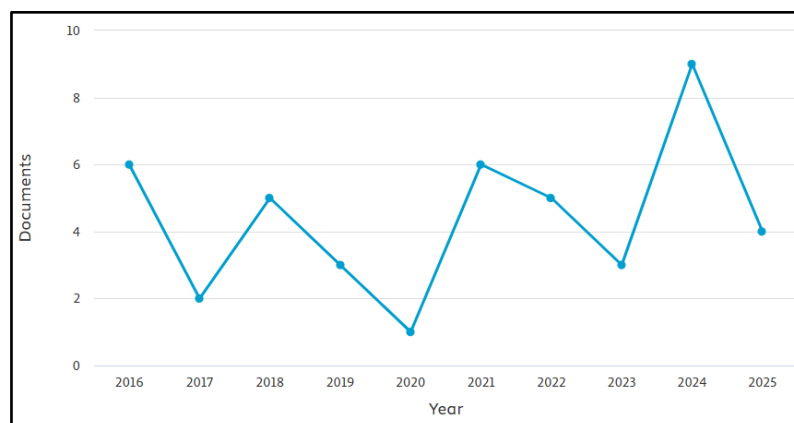


Figure 3: Documents by Year from 2016 until 2025, adopted from Scopus Database

As shown in Figure 3, the period 2016 up to 2025 has an uneven trend of publications on gamification. This variation suggests the difficulties in TVET gamification research and application, though this is not an issue overwhelming the number of such learning in 2024.

Hence, future initiatives need to be focused on standardization alongside continuous effect assessment in a flexible contextual manner.

Conclusion

This article highlights the significance of gamification as an important trend in TVET to enhance student motivation, engagement, and ability. The findings of the reviewed studies show that gamification, which uses technologies such as leader boards, badges and simulations, has the potential to enhance students' engagement and to support competency-based education aligned with Industry 4.0 needs. Its widespread use and effectiveness are limited due to challenges such as low infrastructure, limited teacher training, lack of standardization, and inconsistent empirical validation. There is still a lot of debate on the sustainability of student motivation, fair access to digital resources and the measurable long-term outcomes of the transfer of digital skills and employability. The literature also shows major limitations in the research that analyzed digital technology and learning, including in the longitudinal studies, the cross-cultural studies and the comparative studies, as well as in the pedagogical aspects of digital technology and the gap between the pedagogical theory and the digital practice. Further studies are needed on developing scalable models that can be adapted to different TVET contexts, including the use of standardised assessment tools and evidence-based models. Also, it is important to advance institutional readiness, teacher professional development and collaboration among teachers, legislators and technology developers. By tackling these issues, gamification can develop into a long-lasting and revolutionary teaching approach that gives students the drive, skills, and digital literacy required for the workforce of the future.

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