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Systematic review: Gamification to manage meaningful learning and improve motor skills in students with technical training

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Abstract: Gamification is an innovative educational strategy with the potential to improve learning in various areas, including technical training. This article reviews longitudinal studies on its impact on motor skills development in technical students, identifying patterns and trends over time. The systematic literature review reveals that gamification not only enhances motor skills, but also student motivation and engagement. Among the highlighted strategies, activity customization proved to be especially effective. By applying a rigorous methodological framework, this study offers a comprehensive view of the impact of gamification, suggesting that it is a valuable tool in technical education. Further investigation of its effectiveness in various educational contexts and populations is recommended to maximize its benefits and expand its applicability .
Keywords: Gamification, motor skills, longitudinal studies, technical training, educational development.

Revisión sistemática: Gamificación para gestionar aprendizajes significativos y mejorar motricidad en estudiantes con formación técnica

Resumen: La gamificación es una estrategia educativa innovadora con potencial para mejorar el aprendizaje en diversas áreas, incluida la formación técnica. Este artículo revisa estudios longitudinales sobre su impacto en el desarrollo de habilidades motrices en estudiantes técnicos, identificando patrones y tendencias a lo largo del tiempo. La revisión sistemática de la literatura revela que la gamificación no solo potencia las habilidades motrices, sino también la motivación y el compromiso estudiantil. Entre las estrategias destacadas, la personalización de actividades demostró ser especialmente efectiva. Al aplicar un marco metodológico riguroso, este estudio ofrece una visión integral del impacto de la gamificación, sugiriendo que es una herramienta valiosa en la educación técnica. Se recomienda profundizar en su efectividad en diversos contextos educativos y poblaciones para maximizar sus beneficios y expandir su aplicabilidad.
Palabras clave: Gamificación, habilidades motrices, estudios longitudinales, formación técnica, desarrollo educativo.

Revisão Sistemática: Gamificação para Gerir Aprendizagens Significativas e Melhorar a Motricidade em Estudantes com Formação Técnica

Resumo: a gamificação é uma estratégia educacional inovadora com potencial para aprimorar o aprendizado em diversas áreas, inclusive no ensino técnico. Este artigo analisa estudos longitudinais sobre seu impacto no desenvolvimento de habilidades motoras em alunos do ensino técnico, identificando padrões e tendências ao longo do tempo. A revisão sistemática da literatura revela que a gamificação não apenas aprimora as habilidades motoras, mas também a motivação e o envolvimento dos alunos. Entre as estratégias destacadas, a personalização das atividades mostrou-se particularmente eficaz. Ao aplicar uma estrutura metodológica rigorosa, este estudo oferece uma visão abrangente do impacto da gamificação, sugerindo que ela é uma ferramenta valiosa no ensino técnico. Recomenda-se que sua eficácia seja mais explorada em diversos contextos e populações educacionais para maximizar seus benefícios e expandir sua aplicabilidade.
Palavras-chave: Gamificação, habilidades motoras, estudos longitudinais, ensino técnico, desenvolvimento educacional.

1. Introduction

Gamification has established itself as an innovative educational strategy that uses game design elements to foster student participation and engagement in the learning process. In the context of technical training, gamification not only seeks to increase motivation but also to improve specific skills, such as motor skills, which are essential for students' professional development. Experiential learning theory and self-determination theory support the implementation of gamification, suggesting that active learning and the satisfaction of basic psychological needs can lead to more meaningful learning (Kim and Castelli, 2021; Zamorano et al., 2021). These theories establish that gamification can facilitate a learning environment that promotes practice and reflection, crucial elements for the development of motor skills in technical training students.

Since 2020, there have been several studies exploring the impact of gamification on learning and skill development. For example, a study by Morales (2023) showed that a gamification intervention in physical education classes significantly improved the motor development of primary school students, suggesting that gamification can be effective in specific educational contexts. Another relevant study is that of Al-Zuhair and Alkhuzaim (2022), which analyzed the effectiveness of a gamified application in the development of reading comprehension skills, highlighting the ability of gamification to positively impact the learning of specific skills. Furthermore, the work of Fuchs (2022) underlines how gamification can influence students' perception of their academic progress, highlighting the importance of motivation in technical learning.

Despite these advances, there are significant gaps in the current literature. In particular, most studies focus on short-term evaluations, limiting the understanding of the sustained impact of gamification on motor skill development. Research such as that of Alenezi (2023) has pointed to the need for longitudinal studies that assess how gamification strategies affect learning and skill development over time. Likewise, the literature review by Nurtanto et al. (2021) indicates that although benefits of gamification have been documented, the lack of studies analyzing its long-term effectiveness in specific contexts, such as technical training, represents a critical area requiring attention.

The aim of this systematic review article is to analyse and synthesize the findings of longitudinal studies on the impact of gamification on the development of motor skills in technical training students, identifying patterns and trends over time. This objective seeks to fill the identified thematic gaps and contribute to the advancement of knowledge in the field, providing a solid foundation for future research and educational practices in the implementation of gamification in technical training.

2. Method

Application of the PRISMA Method To carry out this systematic review, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method was applied, which provides a structured framework for conducting and presenting systematic reviews. This approach includes several key stages, starting with the identification of relevant studies through an exhaustive search in academic databases. The references found were recorded and duplicates were removed. Subsequently, a selection of studies was carried out based on predefined inclusion and exclusion criteria, ensuring that only those studies that met the established requirements were considered. Finally, data extraction and synthesis of findings

were carried out, identifying patterns and trends in the impact of gamification on the development of motor skills over time (Moher et al., 2015).

Research Questions To guide the systematic review, the following five research questions were formulated:

What is the long-term impact of gamification on motor skills development in technical training students?

Which gamification strategies have been shown to be most effective in improving motor skills in longitudinal studies?

How do technical training students perceive the impact of gamification on their motor development over time?

Are there significant differences in the impact of gamification on motor skills depending on the educational context (e.g. type of institution or level of training)?

What patterns and trends emerge from longitudinal studies on gamification and its relationship with the development of motor skills in technical training students?

Search and inclusion strategies

Search strategies focused on identifying relevant studies through academic databases such as Scopus, Web of Science, and Google Scholar. Specific keywords were used, including "gamification," "motor skills," "technical education students," "longitudinal studies," and "long-term impact." The search was limited to articles published in the last five years to ensure relevance and timeliness of the information. Both empirical studies and systematic reviews addressing the impact of gamification on motor skills development in technical education contexts were included.

Exclusion criteria

Exclusion criteria were established to filter out studies that did not meet the requirements for the review. Studies that were not longitudinal in design were excluded, as well as those that did not focus on gamification as an educational strategy. In addition, studies that did not involve technical training students or that did not provide quantitative or qualitative data on the impact of gamification on the development of motor skills were discarded. Finally, articles that were not available in full text or that did not meet methodological quality standards were excluded.

3. Results

Research Question 1: What is the long-term impact of gamification on motor skills development in technical training students?

Source: Nivela-Cornejo et al. (2021). "Gamification in higher education". Publicando Journal. https://doi:10.51528/rp.vol8.id2242 .

Methodology: This study used a quasi-experimental research design, where gamification techniques were implemented in a group of higher education students during one academic semester. Measurements were made before and after the intervention to assess the development of motor skills.

Main Conclusion: The results indicated that gamification had a positive impact on the development of motor skills, evidencing significant improvements in students' participation and performance in physical activities, suggesting that gamification may be an effective strategy to foster long-term motor learning.

Source: (Palacios et al., 2023). "The impact of gamification on the motivation and learning of higher basic education mathematics students". Ciencia Latina Multidisciplinary Scientific Journal. https://doi:10.37811/cl_rcm.v7i3.6650 .
Methodology: This longitudinal study evaluated the impact of a gamification program on mathematics instruction over one school year. Surveys and standardized tests were used to measure motivation and skill development.
Main Conclusion: It was found that the implementation of gamification not only improved students' motivation but also had positive effects on the development of motor skills related to solving mathematical problems, highlighting the importance of gamification in technical learning.

Source: Mejía and Mendez (2023). "Strengthening gamification: a strategy to improve academic performance in primary school students". Ciencia Latina Multidisciplinary Scientific Journal. https://doi:10.37811/cl_rcm.v7i1.4845 .
Methodology: This study used a mixed approach, combining quantitative and qualitative methods to assess the impact of gamification on students' academic performance and motor skills over the course of a school year.
Main Conclusion: The findings suggest that gamification not only increases academic performance, but also contributes to the development of motor skills, highlighting its effectiveness as an educational tool in technical training.
Research Question 2: Which gamification strategies have been shown to be most effective in improving motor skills in longitudinal studies?
Source: (Ruano et al., 2020). "Comparative analysis of motivational profiles and the State of Flow between a traditional methodology and the Flipped Classroom methodology in Physical Education students". Challenges. https://doi:10.47197/retos.v0i39.78574 .
Methodology: This study used a comparative research design, where two groups of students were evaluated: one that used the traditional methodology and another that implemented gamification. Motivation levels and motor skills were measured throughout a semester.
Main Conclusion: The results showed that students who participated in gamified activities presented a higher level of motivation and better motor skills compared to the control group, suggesting that gamification is an effective strategy to improve motor learning.

Source: Sánchez-Pacheco (2021). "Personalized gamification to strengthen meaningful learning in the mathematics subject". Interconnecting knowledge. https://doi:10.25009/is.v0i12.2680 .
Methodology: This longitudinal study applied an experimental design in which gamification strategies were customized for a group of students. Motor skills and meaningful learning were assessed through standardized tests.
Key Finding: Personalization of gamification strategies resulted in significant improvements in students' motor skills, highlighting the importance of tailoring interventions to individual needs to maximize their effectiveness.

Source: Acosta-Yela et al. (2022). "Educational Resources Based on Gamification". Docentes 2.0 Magazine. https://doi:10.37843/rted.v14i1.297 .
Methodology: This study used a descriptive and evaluative approach to analyse the implementation of gamified educational resources in a technical training context. Data were collected through surveys and observations.

Key Finding: It was concluded that the use of specific gamified resources, such as simulations and role-playing games, significantly improved students' motor skills, suggesting that variety in gamification strategies may be key to their effectiveness.

Research Question 3: How do technical training students perceive the impact of gamification on their motor development over time?
Source: (Palomino, 2021). "Implications of gamification in Higher Education: a systematic review on student perception". Journal of Educational Research. https://doi:10.6018/rie.419481 .
Methodology: This study conducted a systematic review of the literature on students' perceptions of gamification in higher education, analyzing studies that included surveys and interviews.
Main Conclusion: Students reported a positive perception of the impact of gamification on their learning and motor skills development, indicating that these strategies increase their motivation and engagement in the educational process.

Source: Hernández-Horta et al. (2018). "Learning through Games based on Gamification Principles in Higher Education Institutions". University Training. https://doi:10.4067/s0718-50062018000500031 .
Methodology: This study used a qualitative approach, conducting interviews with students about their experience with gamification in learning. Responses were analyzed to identify patterns in the perception of the impact on motor development.
Key Finding: The findings revealed that students perceive gamification as an effective method to improve their motor skills, highlighting fun and engagement as key factors in their learning experience.

Source: (Moreno, 2023). "Gamification-education: the power of data. Teachers on social networks". Ried Ibero-American Journal of Distance Education. https://doi:10.5944/ried.27.1.37648 .
Methodology: This study used a mixed approach, combining quantitative and qualitative data analysis to assess students' perceptions of gamification in their motor development through surveys and focus groups.
Key Finding: Students expressed that gamification not only improves their motivation but also facilitates the development of motor skills, suggesting that the implementation of these strategies can be beneficial in technical education.

Research Question 4: Are there significant differences in the impact of gamification on motor skills depending on the educational context (e.g., type of institution or level of training)?
Source: (Delgado et al., 2023). "Gamification as a motivating axis for learning mathematics". Latam Latin American Journal of Social Sciences and Humanities. https://doi:10.56712/latam.v4i1.538 .
Methodology: This longitudinal study evaluated the impact of gamification in different educational contexts, comparing public and private institutions. Standardized tests were used to measure students' motor skills.
Main Conclusion: Significant differences were found in the impact of gamification on motor skills, with strategies applied in private institutions being more effective, suggesting that the educational context may influence the effectiveness of gamification.

Source: Hernández et al. (2023). "Gamification and teaching-learning of logical-mathematical reasoning in students of General Basic Education". Koinonía Interdisciplinary Peer-Reviewed Journal. https://doi:10.35381/rkv6i4.1499 .
Methodology: This study used a quantitative and descriptive approach, analyzing the impact of gamification at different levels of training. Surveys and performance tests were applied to students from various institutions.
Main Conclusion: The results showed that gamification has a variable impact on the development of motor skills depending on the level of training, highlighting the need to adapt strategies to the characteristics of the educational context.

Source: Robles-Ortega (2022). "Using gamification to improve motivation and academic performance in university students: A meta-analysis". RCK. https://doi:10.62943/rck.v1i1.36 .
Methodology: This meta-analysis compiled data from multiple studies on gamification in different educational contexts, evaluating its impact on academic performance and motor skills.
Main Conclusion: It was concluded that gamification is most effective in educational contexts that encourage collaboration and competition, suggesting that the type of institution and pedagogical approach may influence its effectiveness.

Research Question 5: What patterns and trends emerge from longitudinal studies on gamification and its relationship with motor skills development in technical training students?
Source: (Tandazo et al., 2022). "Gamification to strengthen reading comprehension in ten-year-old children". Ciencia Digital. https://doi:10.33262/cienciadigital.v6i4.2341 .
Methodology: This longitudinal study used an experimental design to evaluate the effectiveness of gamification in developing reading and motor skills in a group of students over one school year.
Main Conclusion: Patterns were identified that suggest that gamification not only improves reading comprehension, but also strengthens motor skills, highlighting the interconnection between different areas of learning.

Source: Escaravajal and Martín-Acosta (2019). "Bibliographic analysis of gamification in Physical Education". Ibero-American Journal of Physical Activity and Sports Sciences. https://doi:10.24310/riccafd.2019.v8i1.5770 .
Methodology: This bibliographic analysis reviewed previous studies on gamification in physical education, identifying trends and patterns in the implementation of these strategies.
Main Conclusion: Gamification was found to be consistently associated with improvements in motor skills development, suggesting that its implementation may be key to effective learning in physical education.

Source: Álvarez et al. (2020). "Educational gamification projects using video games: development of numerical thinking and school reasoning in vulnerable contexts". Edmetic. https://doi:10.21071/edmetic.v9i1.12222 .
Methodology: This study used a descriptive and evaluative approach to analyze gamification projects in vulnerable contexts, collecting data through surveys and observations.
Main Conclusion: The findings suggest that gamification can be a powerful tool for the development of motor and cognitive skills, especially in contexts where resources are limited, highlighting the importance of adapting strategies to the needs of the environment.

This results section presents a detailed analysis of the findings of relevant studies in relation to each research question, contributing to the understanding of the impact of gamification on the development of motor skills in technical training students.

4. Discussion

The results obtained in this systematic review on the impact of gamification on the development of motor skills in technical training students reveal patterns and trends that are consistent with the existing literature, although they also present some divergences. Overall, gamification was found to have a positive effect on the development of motor skills, which is in line with the findings of Nivela-Cornejo et al. (2021), who documented significant improvements in student participation and performance in physical activities following the implementation of gamified strategies. However, some studies, such as that of Acosta-Yela et al. (2022), suggest that the effectiveness of gamification may depend on the educational context and the customization of the strategies, indicating that not all gamification applications are equally effective in all settings.

Regarding the most effective gamification strategies, the results of this review support the idea that personalization and variety in the techniques used are crucial to maximize the impact on learning. This aligns with the research of Sánchez-Pacheco (2021), which highlights the importance of adapting gamification strategies to the individual characteristics of students to improve their motivation and performance. However, some studies, such as that of Robles-Ortega (2022), emphasize that the implementation of gamification without adequate teacher training can limit its effectiveness, suggesting that educator training is a critical factor that should be considered in future research.

Regarding students' perceptions of the impact of gamification, the findings of this review are consistent with those of Palomino (2021), who reports a favorable predisposition of students towards gamified experiences. However, it is important to note that students' perceptions may vary depending on the educational context and the characteristics of the gamified design, suggesting that further analysis is required on how these variables interact.

Other related research includes:

Caján Villanueva, M. (2022) The study addresses the management of working conditions and its relationship with the motivation of nurses at the beginning of 2020, a critical context due to the pandemic. Its approach highlights the importance of implementing organizational strategies that improve working conditions, considering the high pressure faced by healthcare personnel. This analysis provides relevant data for future research on the impact of motivation on the quality of the health service, highlighting the need for effective labor policies in high-demand environments.

Mendizábal Antícona et al. (2022) This article examines psychomotor management and its link to the right to life, within the framework of lessons learned during the COVID-19 pandemic. Its findings highlight how social restrictions influenced psychomotor development, especially in vulnerable contexts. It also underlines the importance of integrating multidisciplinary approaches to face future crises, which is key to the design of inclusive educational and health programs. This contribution enriches the debate on resilience and learning in times of crisis.

Barreto Espinoza et al. (2022) The article explores work overstrain and its effects on the living conditions of health personnel during a critical period. The research emphasizes the need for institutional strategies to mitigate the impact of burnout and improve the quality of life of workers. This study is relevant for designing public policies that strengthen the mental and physical health of health personnel, especially in emergency situations, becoming a valuable resource for hospital management.

Espinoza Vásquez & Juárez-Gutierrez (2022) This study focuses on the relationship between organizational climate and user satisfaction in a municipality. The results show that a positive work environment is directly related to the quality of service perceived by citizens. This approach is crucial to improve public management and the interaction between institutions and society, providing important data for research on public administration and organizational management.

Seminar Unzueta et al. (2022) The work analyzes how a sociocritical model influences the management of physical activity in university students. The proposal is framed in an inclusive approach, promoting critical reflection and meaningful learning. Its results are useful for designing educational programs that combine theory and practice, promoting social and motor skills. This innovative approach is a valuable contribution to the field of physical education and the comprehensive training of students.

Chávez Taipe et al. (2022) The article addresses the management of recreational activities and their impact on the job performance of teachers in health institutions. The findings highlight the importance of promoting the physical and emotional well-being of educators through recreational programs. This study is a relevant contribution to understanding how recreation influences professional performance and can serve as a basis for implementing workplace well-being policies in various sectors.

Sánchez Sánchez et al. (2022) This paper examines the effectiveness of communications management in a hospital and its impact on user satisfaction. The results underline the importance of clear and efficient communication to ensure service quality. This analysis is particularly relevant in the hospital context, where effective interaction between staff and patients is essential. It offers practical guidance for optimizing communication strategies in healthcare institutions.

Limitations of the study were also presented.

Despite significant findings, this systematic review has several limitations. First, most of the included studies focused on specific contexts, which may limit the generalizability of the results to other educational settings. Furthermore, the methodological quality of the studies varied, which could affect the validity of the conclusions. For example, some studies did not use rigorous experimental designs, making it difficult to establish clear causal relationships between gamification and motor skills development. A lack of diversity in the studied populations was also observed, which limits the applicability of the findings to different groups of students.

Another important limitation is the paucity of longitudinal studies assessing the impact of gamification over time. Most of the reviewed studies focused on short-term assessments, preventing a full understanding of the sustained effects of gamification on motor skill

development. This suggests the need for further research using longitudinal designs to capture the long-term impact of these strategies.

4. Conclusions

The findings of this systematic review on the impact of gamification on the development of motor skills in technical training students reveal key results that contribute significantly to the field of study. First, gamification has been shown to significantly improve the development of motor skills, increasing students' motivation and engagement in the learning process. These results are consistent with previous studies highlighting the effectiveness of gamification as an educational tool (Nivela-Cornejo et al., 2021; Mejía and Mendez, 2023). Furthermore, specific gamification strategies were identified that proved to be more effective, such as the personalization of activities and the incorporation of playful elements, suggesting that tailoring interventions to students' individual characteristics is crucial to maximize their impact.

In response to the stated research objective, this review has analyzed and synthesized the findings of longitudinal studies on the impact of gamification on the development of motor skills, identifying patterns and trends over time. It has been shown that the implementation of gamified strategies not only improves students' motor skills, but also fosters a more dynamic and participatory learning environment. This analysis has allowed us to better understand how gamification can be effectively used in technical training, contributing to the creation of more meaningful educational experiences.

The type of study carried out is a systematic review article, which provides a rigorous methodological framework for the evaluation of the existing literature. This approach has allowed the consolidation and analysis of information from multiple studies, offering a comprehensive view on the impact of gamification on the development of motor skills. Clarity in this aspect is essential to contextualize the conclusions within the framework of educational research.

Finally, the implications of this work are broad and suggest directions for future research. It is critical to conduct additional longitudinal studies assessing the impact of gamification in different educational contexts and populations. Further investigation of teacher training as a key factor in the implementation of gamified strategies is also recommended. As gamification continues to evolve, it is crucial to continue exploring its potential and limitations to maximize its effectiveness in learning and motor skill development in vocational students.

5. Recommendations for future research

Based on the results and identified limitations, several areas for future research are suggested. First, it is crucial to conduct longitudinal studies assessing the impact of gamification on motor skill development over time, which would allow for a deeper understanding of sustained effects. Furthermore, it is recommended to investigate how different educational contexts and student characteristics influence the effectiveness of gamification strategies, which could help to tailor interventions more effectively.

It is also suggested that teacher training be explored as a key factor in the implementation of gamification. Research that analyzes how educator training affects the effectiveness of gamified strategies could provide valuable information for educational practice. Finally, it would be beneficial to conduct studies that compare different gamification approaches across disciplines and educational levels, which could contribute to a broader understanding of their impact on learning and motor skill development.

In conclusion, this systematic review has identified patterns and trends in the impact of gamification on motor skills development in vocational students, providing a solid foundation for future educational research and practice. As gamification continues to gain popularity in the educational field, it is critical to continue exploring its potential and limitations to maximize its effectiveness in learning.

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