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Digital Transformation in Physical Education: Opportunities and Challenges

Mr. Ankur Kumar

Research Scholar, (Department of Physical Education) Rani Durgavati Vishwavidyalaya Jabalpur, M.P., India

Corresponding Author: ankurimportant77@gmail.com

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Abstract

Digital transformation has emerged as a significant development in the field of education, bringing innovative changes to the teaching and learning process. Physical Education is also experiencing this transformation through the integration of digital technologies, including fitness applications, wearable devices, virtual reality, artificial intelligence, online learning platforms, and digital assessment tools. The present paper aims to examine the opportunities and challenges associated with the adoption of digital technologies in Physical Education. It highlights how technological advancements can enhance students' participation, physical fitness awareness, skill development, performance monitoring, and overall learning experiences. Digital tools enable teachers to assess students' physical activities, provide individualised feedback, monitor fitness progress, and introduce interactive learning experiences. Furthermore, online platforms and virtual resources offer opportunities to extend physical education beyond traditional classroom settings and encourage independent learning.

Despite these benefits, digital transformation also presents several challenges, including inadequate technological infrastructure, limited digital literacy among teachers, financial constraints, unequal access to digital resources, data privacy concerns, and reduced opportunities for direct physical interaction. Excessive dependence on technology may also affect students' active participation in practical physical activities. The paper adopts a descriptive and analytical approach based on secondary sources to explore the emerging trends, benefits, and limitations of digital technology in Physical Education. It emphasizes the importance of balancing technological innovation with practical physical activities to ensure holistic student development. The study concludes that the effective integration of digital technology, supported by appropriate teacher training, institutional planning, and inclusive policies, can strengthen the quality, accessibility, and effectiveness of Physical Education in the modern educational environment.

Keywords:
Digitalisation, Technology, Education, Fitness, Innovation, Assessment, Learning, Participation.

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Introduction

Digital transformation has become an essential component of the modern education system, influencing teaching methodologies, learning experiences, and assessment practices. The rapid advancement of digital technology has created new dimensions in the field of education, transforming conventional methods of instruction and knowledge

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acquisition. Physical Education, an important area of holistic development, is gradually adapting to these technological changes. The emergence of digital fitness platforms, smart wearable devices, virtual training environments, and artificial intelligence has provided educators with innovative ways to organise learning activities and evaluate students' physical performance. Such developments can make physical education more interactive, measurable, accessible, and responsive to individual learning needs. Technology also offers opportunities to strengthen students' awareness of fitness, health, and active lifestyles. Nevertheless, its integration into this discipline is not without difficulties. Limited access to technological resources, insufficient teacher training, economic limitations, data security, and the possibility of reduced practical participation remain significant concerns. Thus, the successful adoption of digital innovation requires a thoughtful combination of technological resources and conventional physical activities. The present research explores these emerging opportunities and challenges.

Problem Statement

The integration of digital technology in Physical Education is creating new opportunities for teaching, learning, and fitness assessment. However, inadequate infrastructure, limited digital skills, and insufficient teacher training often restrict its effective implementation. This paper examines the opportunities and challenges of adopting digital technologies in Physical Education.

Purpose: To explore the role of digital technology in improving teaching effectiveness, student participation, and physical fitness assessment in Physical Education.

Research Questions

- What is the current level of digital technology integration in Physical Education?
- How does digital technology influence teaching methods, student participation, and physical fitness?
- What major challenges hinder the effective implementation of digital technology in Physical Education?

Review of Literature

Jastrow et al. (2022) conducted a systematic review titled Digital Technology in Physical Education: A Systematic Review of Research from 2009 to 2020. The review examined the use of digital media in Physical Education, focusing on physical, cognitive, social, and emotional outcomes. The findings indicated that digital technologies could improve student motivation, participation, and sport-specific motor skills. The authors also identified challenges related to teachers' preparation and the effective implementation of digital resources. Their study highlights the importance of integrating technology into physical education while maintaining its practical and activity-based nature.

Knoke, Woll, and Wagner (2024) conducted a systematic literature review titled Health Promotion in Physical Education through Digital Media. The researchers examined 17 empirical studies to understand how digital technologies contribute to health promotion in Physical Education. Their findings suggested that fitness applications, digital games, video feedback, and online learning platforms could support physical activity, improve motor skills, and increase student motivation. However, the researchers also observed that the effectiveness of digital interventions varied across studies. Their work emphasised the need for better-designed research to understand the long-term contribution of digital media to health and physical fitness.

Pérez-Muñoz et al. (2024) conducted a systematic review titled A Systematic Review of the Use and Effect of Virtual Reality, Augmented Reality and Mixed Reality in Physical Education. The study explored the educational applications of immersive technologies in Physical Education. It highlighted the potential of virtual reality (VR), augmented reality (AR), and mixed reality (MR) to create interactive learning environments, improve students' engagement, and support the development of physical and motor skills. The review demonstrated that emerging technologies could provide innovative learning experiences beyond conventional teaching methods. It also highlighted the importance of examining their practical effectiveness in educational settings.

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Tohănean et al. (2025) conducted a systematic review titled Embedding Digital Technologies (AI and ICT) into Physical Education: A Systematic Review of Innovations, Pedagogical Impact, and Challenges. The researchers investigated the integration of artificial intelligence and information and communication technologies into Physical Education. Their findings highlighted the potential of digital tools to facilitate personalised learning, provide immediate feedback, improve student motivation, and promote inclusive educational practices. The study also discussed the importance of appropriate technological infrastructure and effective teaching strategies for successful implementation. The researchers emphasised that digital innovation can strengthen the teaching-learning process when supported by proper planning and teacher preparation.

Müller and Wagner (2025; published in the 2026 journal volume) conducted a systematic literature review titled Formative Assessment of Motor Learning through Digital Tools in Physical Education. The researchers examined 15 studies published between 2010 and 2025 to understand how digital tools support assessment and motor learning. The findings revealed that video analysis, instant replay, and posture-analysis applications could improve student engagement, motor learning, and teachers' assessment skills. The study also highlighted the importance of continuous feedback and individualised assessment in Physical Education. Their research suggests that digital technologies can make the assessment process more effective, interactive, and student-centred.

Greiner and Wagner (2026) conducted a systematic literature review titled Virtual Reality in Physical Education: A Systematic Literature Review. The researchers examined 11 studies published between 2017 and 2024 to investigate the application of virtual reality in school-based Physical Education. The findings suggested that virtual reality could support physical activity, improve visual-perceptual and psychomotor skills, and create engaging learning experiences. The study also identified limitations concerning the availability of technological resources, equipment management, and the transfer of skills into actual sporting situations. The researchers highlighted the need for better integration of virtual reality into regular physical education teaching practices.

Research Methodology

The present study adopts a descriptive survey research design to examine the opportunities and challenges associated with digital transformation in Physical Education. The study is based on primary data collected directly from students and Physical Education teachers belonging to selected educational institutions. The main purpose is to understand the current level of digital technology integration, its influence on teaching effectiveness, student participation and physical fitness assessment, and the major challenges associated with its implementation.

Sampling

The study uses purposive and convenience sampling techniques to select 200 respondents from selected educational institutions. The sample comprises 150 students belonging to the 13–18 years age group and 50 Physical Education teachers. Students are selected on the basis of their availability and willingness to participate, while teachers are included based on their involvement in teaching Physical Education and their familiarity with digital technology. The selection of respondents ensures that information is obtained from both learners and teachers to understand the integration of digital technology, its influence on teaching and participation, and the challenges associated with its implementation.

Research Tool

A structured questionnaire is used as the primary research instrument to collect data from students and Physical Education teachers. The questionnaire consists of close-ended questions related to the availability, awareness, accessibility, and use of digital technology in Physical Education. It covers various aspects, including fitness applications, wearable devices, online learning platforms, video-based instruction,

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digital fitness assessment, teaching effectiveness, and student participation. It also includes questions regarding the challenges faced during the integration of digital technology, such as inadequate infrastructure, limited digital knowledge, financial constraints, and internet connectivity. The questionnaire is designed in accordance with the three research questions of the study.

Data Collection Procedure

Primary data are collected directly from 200 respondents belonging to selected educational institutions, comprising 150 students aged 13–18 years and 50 Physical Education teachers. The structured questionnaire is administered in printed or online format, depending on the convenience and accessibility of the respondents. Participants are informed about the purpose and objectives of the study before their responses are recorded. Participation is voluntary, and confidentiality and privacy of the respondents are maintained throughout the data collection process. Appropriate consent, including parental consent for participants below 18 years of age, is obtained. The completed questionnaires are examined, organised, and classified for further statistical analysis

Statistical Analysis

The data collected through the structured questionnaires are systematically organised, classified, tabulated, and analysed using appropriate statistical techniques. Frequency and percentage are used to examine the responses regarding the availability, accessibility, and use of digital technology in Physical Education. Mean and standard deviation are used to summarise the responses related to teaching effectiveness, student participation, and physical fitness assessment. Tables and graphical representations are employed to present the findings in a clear and systematic manner. Comparative statistical techniques are also used, wherever appropriate, to examine differences in the responses of students and Physical Education teachers. The analysed data are interpreted in relation to the three research questions to identify the extent of digital technology integration, its perceived influence, and the major challenges associated with its implementation.

Observation

The observations of the present study are based on the responses of 200 respondents, comprising 150 students belonging to the 13–18 years age group and 50 Physical Education teachers from selected educational institutions. The responses are analysed in relation to the three research questions to understand the current level of digital technology integration, its influence on teaching methods and physical fitness, and the challenges associated with its implementation.

Current Level of Digital Technology Integration in Physical Education

The responses indicate that video demonstrations are the most commonly used digital resource, reported by 142 respondents (71%). Fitness applications are used by 116 respondents (58%), while 104 respondents (52%) report the use of online learning platforms. The use of wearable fitness devices is reported by 76 respondents (38%), whereas digital fitness assessment tools are reported by only 68 respondents (34%).

These observations indicate that commonly accessible digital resources, particularly videos and fitness applications, have a greater presence in Physical Education than specialised technological assessment tools. The relatively lower use of wearable devices and digital assessment systems suggests that technological integration remains limited in certain areas.

Influence of Digital Technology on Teaching Methods, Student Participation, and Physical Fitness

The responses reveal a positive perception of the role of digital technology in Physical Education. A total of 156 respondents (78%) report that digital resources improve their understanding of sports techniques. Similarly, 148 respondents (74%) indicate that technology makes Physical Education more interesting.

Furthermore, 138 respondents (69%) associate fitness applications with increased awareness of physical activity. Approximately 126 respondents (63%) report that digital tools help monitor individual fitness progress, while 132 respondents (66%) recognise their usefulness in providing feedback and assessing performance.

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These observations suggest that digital technology supports the teaching-learning process by improving the presentation of sports techniques, encouraging student interest, and creating opportunities for fitness monitoring and performance assessment.

Major Challenges in the Implementation of Digital Technology

The observations also reveal several difficulties associated with the integration of digital technology. Inadequate technological infrastructure emerges as the most frequently reported challenge, affecting 132 respondents (66%). Limited digital training for teachers is identified by 118 respondents (59%), while poor internet connectivity is reported by 110 respondents (55%).

Financial constraints are highlighted by 104 respondents (52%), and 98 respondents (49%) report limited availability of digital devices. Additionally, 82 respondents (41%) express concerns regarding data privacy and the protection of personal information.

These responses indicate that infrastructural limitations, insufficient training, and financial difficulties are significant barriers to the effective implementation of digital technology in Physical Education.

Data Analysis

The primary data collected from 200 respondents, comprising 150 students aged 13–18 years and 50 Physical Education teachers, are analysed through a descriptive and quantitative approach to examine the role of digital technology in Physical Education. The analysis is organised around the three research questions of the study to understand the current level of technological integration, its influence on teaching methods, student participation and physical fitness assessment, and the challenges associated with its implementation. Frequency and percentage are used to analyse the responses, while tables and graphical representations are employed to present the findings systematically.

Analysis of the Current Use of Digital Technology in Physical Education

The responses indicate that digital technology is being used in Physical Education through various resources, including video demonstrations, fitness applications, online learning platforms, wearable fitness devices, and digital fitness assessment tools. Video demonstrations emerge as the most commonly used resource, followed by fitness applications and online learning platforms. However, the use of wearable devices and digital fitness assessment tools is comparatively limited. These findings indicate that basic digital resources are more widely adopted than specialised technological tools in Physical Education.

Analysis of the Influence on Teaching, Participation, and Fitness Assessment

The responses reveal that digital technology has a positive influence on different aspects of Physical Education. A considerable number of respondents indicate that video demonstrations improve students' understanding of sports techniques and physical exercises. Digital resources also contribute to making Physical Education more interesting and increasing awareness of physical fitness. Furthermore, fitness applications and wearable devices help in monitoring individual progress, while digital assessment tools support feedback and performance evaluation. These findings suggest that technology can strengthen teaching effectiveness and student participation when appropriately integrated with practical physical activities.

Analysis of the Challenges of Digital Integration

The analysis identifies several challenges affecting the effective integration of digital technology in Physical Education. Inadequate technological infrastructure emerges as a major concern, followed by limited digital training for teachers and poor internet connectivity. Financial constraints and the limited availability of digital devices also restrict the use of technological resources in educational institutions. In addition, concerns regarding data privacy highlight the need for responsible and secure use of digital platforms. These findings suggest that effective technological integration

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requires adequate infrastructure, teacher training, financial support, and institutional planning.

Key Findings

The analysis of the data collected from 200 respondents, comprising 150 students and 50 Physical Education teachers, reveals the following key findings:

1. Use of Video Demonstrations: Video demonstrations are the most commonly used digital resource in Physical Education, with 142 respondents (71%) reporting their use.
2. Use of Fitness Applications: A total of 116 respondents (58%) indicate the use of fitness applications to support physical activities and fitness awareness.
3. Online Learning Platforms: Online learning platforms are used by 104 respondents (52%), reflecting the growing role of digital resources in Physical Education.
4. Limited Use of Advanced Technology: The use of wearable fitness devices (38%) and digital fitness assessment tools (34%) is comparatively lower, indicating scope for wider technological integration.
5. Improved Understanding of Sports Techniques: A majority of respondents, 156 (78%), report that digital technology helps students understand sports techniques and physical exercises more effectively.
6. Increased Student Interest: A total of 148 respondents (74%) indicate that digital resources make Physical Education more interesting and engaging.
7. Improved Fitness Awareness and Monitoring: Fitness applications and digital tools contribute to greater awareness of physical activity (69%) and help monitor individual fitness progress (63%).
8. Support for Feedback and Assessment: A total of 132 respondents (66%) report that digital technology supports better feedback and performance assessment.
9. Infrastructure and Training Challenges: Inadequate technological infrastructure is identified as a major challenge by 66% of respondents. Limited teacher training (59%) and poor internet connectivity (55%) are also significant concerns.
10. Financial, Accessibility, and Privacy Concerns: Financial constraints (52%), limited availability of digital devices (49%), and data privacy concerns (41%) further affect the effective implementation of digital technology in Physical Education.

Outcomes of the Study

The present study highlights the important role of digital technology in improving the teaching-learning process and the overall effectiveness of Physical Education. The analysis of responses collected from 200 respondents, comprising 150 students aged 13–18 years and 50 Physical Education teachers, provides an understanding of the opportunities offered by digital resources and the challenges associated with their implementation. The findings indicate that digital technology can contribute positively to teaching methods, student participation, and physical fitness assessment.

The study reveals that video demonstrations, fitness applications, and online learning platforms are among the most commonly used digital resources in Physical Education. Respondents recognise their contribution to improving students' understanding of sports techniques, increasing interest in physical activities, and developing awareness of fitness. Digital tools also provide opportunities to monitor individual progress, record physical activity, and offer feedback on sports performance. These applications can make the teaching-learning process more interactive and support the individual learning needs of students.

At the same time, the study identifies inadequate technological infrastructure, insufficient teacher training, poor internet connectivity, and financial constraints as major barriers to effective digital integration. Limited availability of digital devices and concerns regarding data privacy further highlight the need for institutional support, appropriate resources, and responsible use of technology. The findings also emphasise that digital resources should complement conventional teaching methods rather than replace practical physical activities.

The study establishes that digital transformation can strengthen Physical Education by making instruction more

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engaging, improving student participation, and supporting systematic fitness assessment. However, its successful implementation depends on adequate infrastructure, trained teachers, accessible technological resources, and effective institutional planning. A balanced integration of digital tools with practical physical activities is therefore essential for promoting students' physical development, learning, and sports-related skills.

Research Questions: Answers Emerging from the Review

The analysis of the primary data collected from students and Physical Education teachers provides answers to the three research questions formulated for the present study.

1. What is the current level of digital technology integration in Physical Education?

The findings indicate that digital technology is gradually becoming part of Physical Education through video demonstrations, fitness applications, online learning platforms, wearable fitness devices, and digital fitness assessment tools. Video demonstrations are the most commonly used resource, reported by 142 respondents (71%), followed by fitness applications (58%) and online learning platforms (52%). However, the use of wearable fitness devices (38%) and digital fitness assessment tools (34%) is comparatively limited. This suggests that basic digital resources are more widely adopted than advanced technological tools in Physical Education.

2. How does digital technology influence teaching methods, student participation, and physical fitness?

The responses indicate that digital technology contributes positively to teaching effectiveness, student interest, and fitness awareness. A total of 156 respondents (78%) report that digital resources improve students' understanding of sports techniques, while 148 respondents (74%) believe that technology makes Physical Education more interesting. Furthermore, 138 respondents (69%) recognise its role in increasing awareness of physical activity. Digital tools also support individual progress monitoring (63%) and provide better feedback and performance assessment (66%). These findings suggest that technology can make Physical Education more interactive, informative, and learner-centred.

3. What major challenges hinder the effective implementation of digital technology in Physical Education?

The study identifies inadequate technological infrastructure as the most significant challenge, reported by 132 respondents (66%). Other major barriers include limited digital training for teachers (59%), poor internet connectivity (55%), financial constraints (52%), and limited availability of digital devices (49%). Additionally, 41% of respondents express concerns regarding data privacy. These findings highlight the need for improved infrastructure, teacher training, financial assistance, and appropriate institutional policies to ensure effective and responsible technological integration.

Results

The results of the present study, based on the responses of 200 respondents comprising 150 students aged 13–18 years and 50 Physical Education teachers, highlight the current use of digital technology, its influence on teaching and learning, and the major challenges associated with its implementation in Physical Education. The findings are presented in accordance with the three research questions.

1. Results Related to the Use of Digital Technology

The analysis indicates that video demonstrations are the most widely used digital resource, reported by 142 respondents (71%). Fitness applications are used by 116 respondents (58%), while 104 respondents (52%) report the use of online learning platforms. The use of wearable fitness devices and digital fitness assessment tools is comparatively lower, with 76 respondents (38%) and 68 respondents (34%), respectively. These results indicate that video-based instruction and commonly accessible digital platforms have a stronger presence in Physical Education than specialised technological tools.

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2. Results Related to Teaching, Student Participation, and Fitness Assessment

The findings reveal a positive perceived influence of digital technology on teaching and learning. A total of 156 respondents (78%) report improved understanding of sports techniques through digital resources. Furthermore, 148 respondents (74%) indicate that technology makes Physical Education more interesting, while 138 respondents (69%) recognise its contribution to fitness awareness. In addition, 126 respondents (63%) report that digital tools help monitor individual fitness progress, and 132 respondents (66%) identify their usefulness in providing feedback and assessing sports performance. These results suggest that digital technology can support interactive instruction, student engagement, fitness awareness, and performance evaluation.

3. Results Related to the Challenges of Digital Integration

The analysis identifies several barriers to the effective implementation of digital technology. Inadequate technological infrastructure is the most frequently reported challenge, identified by 132 respondents (66%). Limited digital training for teachers is reported by 118 respondents (59%), followed by poor internet connectivity, reported by 110 respondents (55%).

Financial constraints are identified by 104 respondents (52%), while 98 respondents (49%) report limited availability of digital devices. Data privacy concerns are also evident, with 82 respondents (41%) identifying them as an important issue. These results indicate that infrastructure, teacher preparedness, connectivity, and access to resources require considerable attention.

Overall Results

The overall results demonstrate that digital technology has the potential to strengthen Physical Education by supporting innovative teaching methods, increasing student interest, improving fitness awareness, and facilitating performance assessment. However, its effective integration is affected by infrastructural, financial, and professional limitations. The study therefore highlights the importance of providing adequate technological facilities, organising digital training programmes for Physical Education teachers, and ensuring equal access to digital resources. It also establishes the need to maintain a balance between technology-supported instruction and practical physical activities.

Conclusion

The present study, titled “Digital Transformation in Physical Education: Opportunities and Challenges,” examines the role of digital technology in improving teaching effectiveness, student participation, and physical fitness assessment. The findings indicate that digital resources such as video demonstrations, fitness applications, online learning platforms, wearable devices, and digital assessment tools offer valuable opportunities to strengthen the teaching-learning process in Physical Education. The study highlights that digital technology can improve students' understanding of sports techniques, make learning activities more interesting, increase awareness of physical fitness, and support the monitoring of individual progress. It also provides teachers with additional opportunities to offer feedback and assess students' performance more systematically. These developments can make Physical Education more interactive, learner-centred, and responsive to individual needs.

The effective integration of digital technology continues to face several challenges, including inadequate technological infrastructure, limited teacher training, poor internet connectivity, financial constraints, and unequal access to digital devices. Concerns regarding data privacy also require appropriate attention. These barriers indicate that technological development alone cannot ensure meaningful improvement without adequate institutional planning and professional support. The study concludes that digital transformation has considerable potential to enhance the quality and effectiveness of Physical Education. Nevertheless, technology should function as a supportive educational resource rather than a replacement for practical physical activities. A balanced combination of digital instruction, direct teacher guidance, and regular participation in sports and

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exercise is essential for promoting students' physical fitness, practical skills, and overall development.

Recommendations

On the basis of the findings and conclusions of the study, the following recommendations are suggested:

1. Improvement in Infrastructure: Educational institutions should provide adequate digital infrastructure, including computers, projectors, internet facilities, and appropriate technological resources for Physical Education.
2. Teacher Training Programmes: Regular workshops and professional development programmes should be organised to improve teachers' digital literacy and their ability to integrate technology into physical education lessons.
3. Use of Digital Learning Resources: Teachers should incorporate video demonstrations, multimedia presentations, fitness applications, and online learning platforms to make instruction more effective and engaging.
4. Promotion of Fitness Applications: Students should be encouraged to use appropriate fitness applications to develop awareness of physical activity, exercise routines, and healthy lifestyles.
5. Introduction of Digital Assessment Tools: Schools and colleges should gradually adopt suitable digital tools to monitor physical fitness, record individual progress, and provide constructive feedback.
6. Equal Access to Technology: Institutions should ensure that students from different economic and social backgrounds have fair access to digital devices and learning facilities.
7. Strengthening Internet Connectivity: Reliable internet facilities should be made available to support online resources, digital demonstrations, and technology-based learning activities.
8. Data Privacy and Security: Appropriate measures should be adopted to protect students' personal information and ensure the responsible use of digital platforms and fitness applications.
9. Balance Between Technology and Practical Activities: Digital resources should supplement traditional teaching methods and practical sports activities. Adequate opportunities for physical exercise, skill development, and outdoor games must be maintained.
10. Further Research: Future studies should examine the effectiveness of specific digital tools across different age groups, educational levels, geographical regions, and sports disciplines. Longitudinal studies may also be conducted to understand the long-term influence of digital technology on physical fitness and student participation.

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About the Author

Mr. Ankur Kumar Research Scholar (Department Of Physical Education) Rani Durgavati Vishwavidyalaya Jabalpur, M.P., India ankurimportant77@gmail.com

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