The Potential of Sketchfab in Visualizing Technical Processes in the Educational Environment

Liubov Khomenko, Poltava V.G. Korolenko National Pedagogical University, Ukraine
Lesia Matviienko, Poltava State Agrarian University, Ukraine
Serhii Kashuba, Poltava V.G. Korolenko National Pedagogical University, Ukraine

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Abstract

This study analyzes the educational affordances of Sketchfab as a digital platform for representing technological processes through interactive 3D models, emphasizing its relevance for STEM and technology education. The paper considers how the use of three-dimensional visualization contributes to improved academic performance by enabling learners to interpret complex technological phenomena more effectively and by supporting the development of advanced spatial reasoning. The research is framed within the ongoing shift toward the digitalization of learning environments and the increased incorporation of immersive technologies into pedagogical practice. To investigate these aspects, a mixed-methods methodology was applied, integrating statistical evaluation of user activity with qualitative data gathered from educator and student interviews and survey responses. Results demonstrate a substantial increase in the adoption of Sketchfab among both educators and learners between 2023 and 2024, with teacher utilization increasing by 40% and student engagement rising by 37.5%. The platform is predominantly employed for the visualization of 3D models, the facilitation of project-based learning, and the enhancement of laboratory-based activities. Students reported a high level of satisfaction: 85% agreed that Sketchfab improved their comprehension of complex disciplinary content, while 90% indicated that it contributed to the development of their spatial reasoning skills. The findings indicate that Sketchfab provides significant pedagogical value, particularly within technical and STEM-oriented educational contexts. The integration of Sketchfab into instructional design not only enriches multimodal content delivery but also promotes learner autonomy and collaboration.

Keywords: Sketchfab, 3D visualization, STEM education, spatial reasoning, project-based learning

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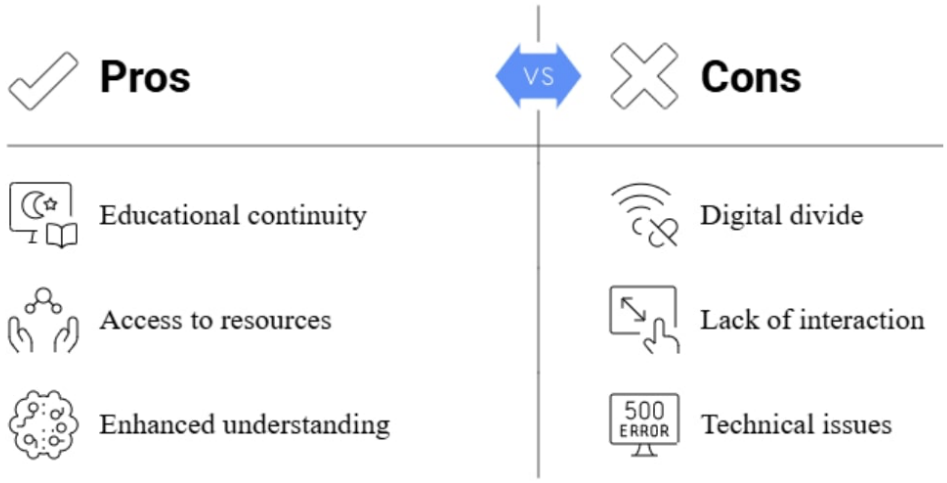
Introduction

In the contemporary educational landscape, increased emphasis is placed on the integration of advanced digital technologies-particularly virtual 3D modeling tools-to enhance the quality and effectiveness of the learning process. One such innovative resource is Sketchfab, an online platform for creating, displaying, and interacting with 3D models, which possesses the potential to transform approaches to the visualization of technical processes within educational institutions (Areshonkov, 2020). The affordances of Sketchfab contribute to more immersive, interactive, and learner-centered instruction, which is especially important in the context of technical and engineering education.

In the conditions of martial law in Ukraine, the educational system has encountered significant challenges that necessitate the adoption of flexible and resilient instructional solutions. As illustrated in Figure 1, "Virtual Education in Ukraine," virtual learning technologies have gained particular relevance, ensuring pedagogical continuity by providing access to high-quality digital learning resources despite restrictions on physical presence and limited infrastructural capacity (Rani, 2025). Within this context, Sketchfab emerges as a powerful pedagogical instrument for teaching technical disciplines, as the platform enables precise modeling and visualization of complex technological processes. This, in turn, supports the development of deeper conceptual understanding and facilitates the integration of theoretical knowledge with practical application in a safe, accessible, and digitally enriched learning environment.

Figure 1
Virtual Education in Ukraine



The relevance of this study is determined by the urgent need to adapt the educational process to contemporary realities, particularly under conditions in which traditional instructional approaches are disrupted by constraints associated with military operations (Efimov, 2020).

To advance the modernization of engineering education in Ukraine, it is essential not only to conduct theoretical investigations but also to implement practice-oriented research that fosters independent, creative, and innovation-driven thinking among future engineers. The integration of advanced digital technologies into the instructional process-particularly 3D modeling tools-contributes to the expansion of students' professional worldview, strengthens their cognitive engagement, and promotes the development of transversal and domain-specific scientific competencies.

Integrating advanced digital tools for the visualization of technical processes also enhances learning effectiveness, supports multimodal cognition, and sustains high educational standards even in exceptional or crisis-driven contexts, including the current conditions of martial law in Ukraine. Within this framework, the Sketchfab platform serves as an immersive visualization environment that enables engineering students to explore object modeling and create interactive 3D representations across various stages of professional preparation.

Despite these advantages, there remains a significant need to improve the instructional and methodological support that ensures the pedagogically sound integration of such tools into the educational process. Therefore, the purpose of this article is to examine the pedagogical potential of using Sketchfab as an immersive visualization platform for representing technical processes within the educational environment and to identify existing challenges along with possible solutions that can ensure high-quality professional training in Ukraine's contemporary educational ecosystem.

Materials and Methods

To solve the problem, the following set of methods was used: theoretical analysis, diagnostic, teaching methods, primary statistical processing, and generalization of the obtained data.

Results and Discussion

The study examined the role and significance of visualization technologies in contemporary educational practice, highlighting their potential in the development of technical competencies within engineering education. Particular emphasis was placed on the application of 3D modeling tools, specifically the Sketchfab platform, for the visualization of technical processes in an educational environment, with consideration of the constraints imposed by the state of martial law in Ukraine.

This research is grounded in a comprehensive analysis of current trends in digital education and their transformative impact on the teaching and learning process. The focus was placed on enhancing technical competence among engineering students under conditions of limited resources and a complex security context, emphasizing the need for resilient and adaptable educational strategies.

To achieve these objectives, an extensive review of scientific literature on the integration of 3D modeling and virtual reality in technical education was conducted. Special attention was given to studies exploring the adaptation of instructional design and pedagogical strategies during periods of military conflict and instability.

The study also incorporated the practical implementation of virtual 3D models developed on the Sketchfab platform within technical discipline classes for both secondary school and engineering students. These models illustrated technical processes, mechanisms, and technological applications, thereby facilitating the translation of theoretical knowledge into practical understanding and supporting experiential learning in constrained educational settings.

A comprehensive content analysis of materials available on the Sketchfab platform was conducted to evaluate their educational potential within the Ukrainian context, particularly considering the adaptations required under martial law conditions. This analysis focused on

multiple dimensions, including the technical quality of 3D models, the availability of step-by-step instructional guidance, interactivity features, accessibility under limited technological resources, and the alignment of digital resources with specific educational objectives and expected learning outcomes.

The study revealed that Sketchfab models vary in complexity, from basic visualizations suitable for introductory lessons to highly detailed simulations for advanced technical training. Instructional guidance often included annotations, embedded instructions, and interactive labels, which enhanced students' ability to engage with the content independently. These features were particularly valuable in situations where classroom teaching was disrupted due to emergency conditions, as they allowed students to continue learning in a self-directed and flexible manner.

To summarize the findings, the analysis results are presented in Table 1, highlighting key aspects of Sketchfab materials and their alignment with Ukrainian educational standards under martial law conditions.

Furthermore, a comparative evaluation was conducted between conventional teaching methods for technical processes and the use of digital 3D models. The analysis highlighted that 3D visualizations significantly improve spatial reasoning, engagement, and comprehension of complex systems, while traditional methods often require more physical resources and direct teacher supervision.

Overall, these research methods provide a comprehensive understanding of Sketchfab's potential as a pedagogical tool for visualizing complex technical processes, supporting active learning, and ensuring continuity of education in emergency and resource-limited conditions.

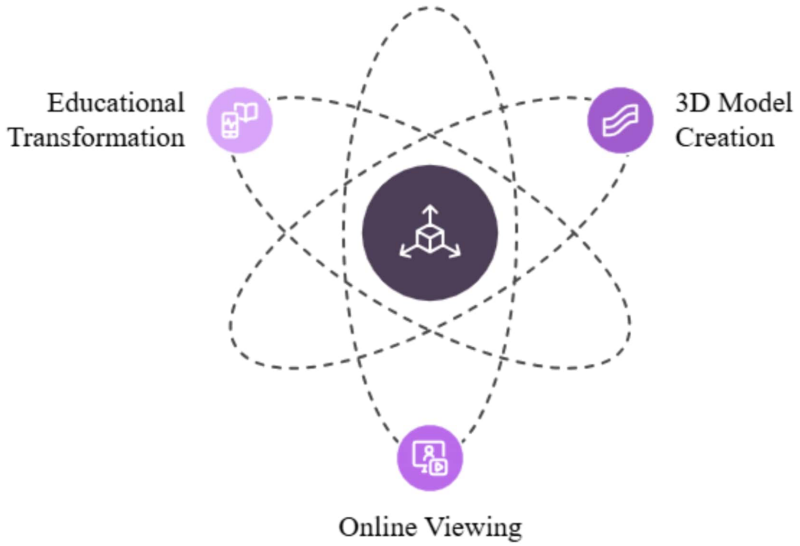
The figure illustrates how Sketchfab 3D models facilitate interactive learning, support curriculum alignment, and enhance student engagement, particularly under conditions of emergency education Figure 2.

Table 1

Content Analysis of Sketchfab Educational Materials

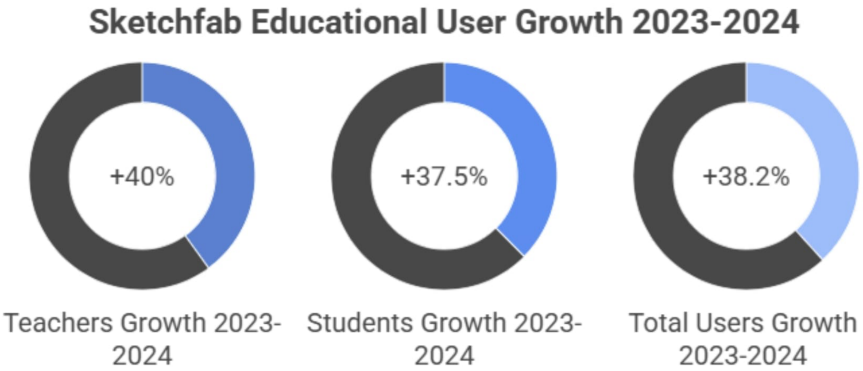
Dimension	Observed Characteristics	Educational Relevance
Technical Quality	High-resolution 3D models, some low-poly models	Facilitates accurate visualization of technical processes
Instructional Guidance	Step-by-step instructions, annotations, interactive labels	Supports self-directed learning and independent practice
Alignment with Learning Outcomes	Models mapped to curriculum objectives	Ensures relevance for technical, STEM, and vocational education
Accessibility	Requires internet access and moderate device specifications	May limit usability under constrained resources
Interactivity	Rotation, zoom, embedded animations, measurement	Enhances spatial understanding and cognitive engagement
Adaptability	Models adaptable to emergency teaching contexts	Maintains continuity of education under martial law and resource constraints

Figure 2
Sketchfab's Impact on Education



The first graph illustrates the growth dynamics of Sketchfab users in the educational sector from 2023 to 2024, categorized into teachers, students, and the total number of users (Figure 3). The data indicate a significant increase in adoption, with the number of teachers using Sketchfab rising from 320 in 2023 to 450 in 2024, representing a 40% growth. Similarly, student engagement has increased from 1,200 to 1,650 users, reflecting a 37.5% rise. Overall, the total number of users has grown from 1,520 to 2,100, marking an increase of 38.2%.

Figure 3
Number of Sketchfab Users Among Teachers and Students



The observed upward trend reflects an increasing recognition of Sketchfab's pedagogical affordances in promoting digital literacy, facilitating immersive learning experiences, and supporting interdisciplinary educational approaches. The growing adoption of the platform by educators underscores its integration into instructional design, particularly within STEM education, where three-dimensional visualization contributes to cognitive load management, spatial reasoning development, and conceptual understanding.

A notable increase in student engagement suggests a paradigm shift toward interactive and constructivist learning environments. In such contexts, learners actively explore, manipulate, and analyze 3D content, constructing knowledge through experiential and inquiry-based

approaches. This aligns with contemporary pedagogical frameworks that emphasize multimodal representations of information, active learning strategies, and student-centered methodologies.

The expansion of Sketchfab usage can also be linked to the broader digitalization of education, the demand for remote and blended learning solutions, and the growing interest in immersive educational technologies. These trends highlight the necessity for systematic research on the effects of 3D visualization tools on learning outcomes and the development of evidence-based strategies for their effective pedagogical implementation.

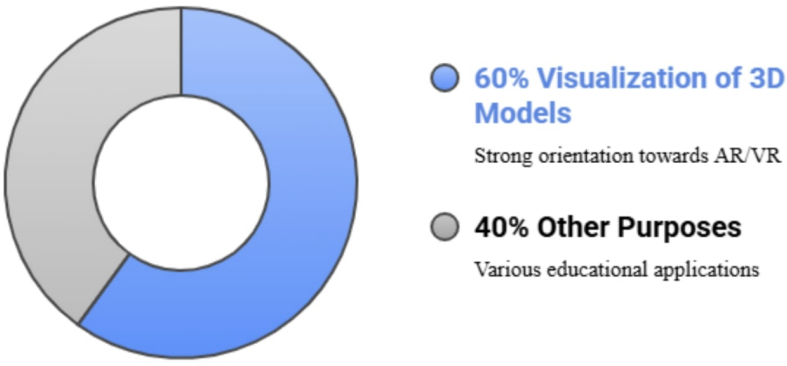
Analysis of the collected data indicates that Sketchfab is widely utilized in educational settings, primarily due to its potential to enhance visualization of learning materials and to support project-based and collaborative learning experiences. Its adoption represents a meaningful step toward integrating advanced digital tools to enrich the teaching and learning process.

The analysis of the collected data demonstrates that the predominant objective for integrating Sketchfab into the educational process is the visualization of 3D models, with 60% of educators emphasizing this purpose (see Figure 4). This finding underscores a pronounced orientation of contemporary teaching practices toward immersive technologies, including augmented reality (AR) and virtual reality (VR), which are increasingly recognized as transformative tools in modern pedagogy.

The integration of 3D and virtual models into instruction plays a significant role in fostering both domain-specific and interdisciplinary competencies. By providing a tangible representation of abstract and complex phenomena, these digital tools enhance conceptual understanding and support the cognitive processes involved in learning technical and scientific content.

Furthermore, the employment of virtual visualization strategies contributes to the development of higher-order thinking skills, such as spatial reasoning, problem-solving, and analytical thinking. This approach aligns with contemporary educational paradigms that prioritize experiential and constructivist learning, enabling students to interact dynamically with subject matter in ways that traditional methods cannot replicate.

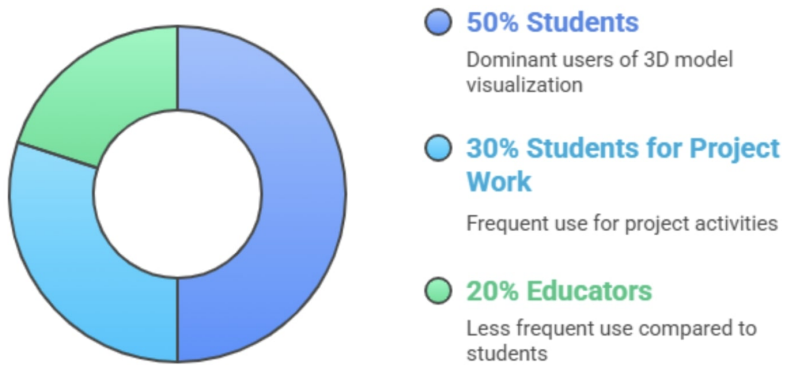
Figure 4
Pedagogical Priorities of Using Sketchfab in Education



Among students, 3D model visualization also dominates (50%), yet they use the platform more frequently for project work (30%) compared to educators (20%). This trend aligns with modern

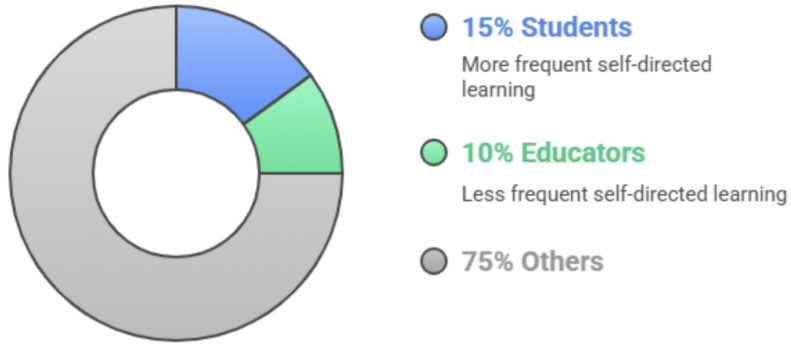
requirements for developing project-based competencies and implementing inquiry-based learning methodologies (Figure 5).

Figure 5
Distribution of 3D Model Visualization Usage



Interestingly, students utilize Sketchfab for self-directed learning (15%) more often than educators (10%) (Figure 6). This underscores the growing importance of self-regulated learning environments and reinforces the relevance of blended learning and flipped classroom methodologies.

Figure 6
Sketchfab Usage for Self-Directed Learning



The utilization of Sketchfab for laboratory activities appears to be minimal, with only 5% of students and 10% of educators reporting its use. This suggests that the integration of 3D models into laboratory settings may necessitate additional pedagogical scaffolding, as well as access to specialized technical infrastructure. Incorporating such resources effectively requires careful instructional design to ensure meaningful engagement and learning outcomes.

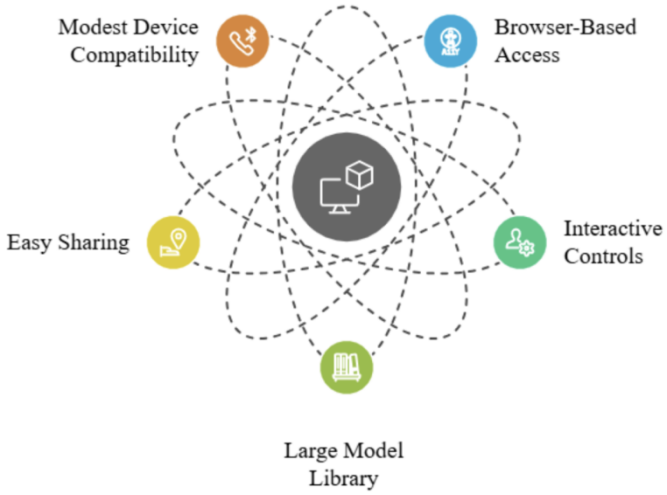
Overall, the analyzed findings substantiate that the incorporation of digital tools, specifically Sketchfab, contributes significantly to the development of digital literacy, facilitates the practical implementation of STEM education frameworks, and enhances cognitive engagement through interactive and immersive learning experiences.

Optimizing instructional strategies through virtual and 3D technologies can markedly increase the effectiveness of the educational process, aligning pedagogical practices with the evolving

requirements of the contemporary educational landscape. As illustrated in Figure 7. Enhancing Education with 3D Models, the model demonstrates how interactive 3D visualization can serve as a catalyst for deeper conceptual understanding, foster experiential learning, and provide learners with a dynamic platform for exploration and experimentation.

Research evidence demonstrates the active utilization of the Sketchfab platform by both educators and learners. Instructors engage with the platform for an average of 3.5 hours per week, indicating its integration into instructional practices, particularly for the visualization and creation of 3D models that support cross-disciplinary applications. This practice aligns with contemporary constructivist approaches, emphasizing experiential and visual learning strategies.

Figure 7
Enhancing Education With 3D Model



Students, in turn, devote more time to Sketchfab, averaging 5.2 hours per week, reflecting heightened motivation, engagement, and learner-centered participation in educational activities. Such intensive interaction with digital 3D tools highlights the platform's potential to enhance cognitive and metacognitive skills, including spatial reasoning, imaginative thinking, and autonomous learning. The overall mean usage of 4.3 hours per week illustrates a broader trend toward interactive, technology-enhanced pedagogies that foster active and personalized learning experiences.

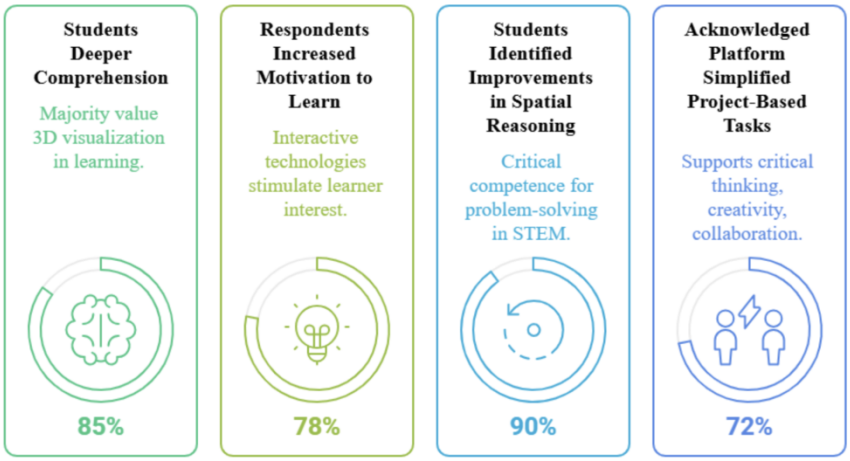
Survey results presented in Table 2 further underscore the pedagogical efficacy of Sketchfab. A substantial majority of students (85%) indicated that the platform facilitates deeper comprehension of learning materials, demonstrating the value of 3D visualization in promoting conceptual understanding and knowledge acquisition in complex academic domains. Additionally, 78% of respondents reported increased motivation to learn, highlighting the role of interactive and visually mediated technologies in stimulating learner interest and sustained engagement.

Table 2
Impact of Using Sketchfab on Learning Outcomes (Survey of Students)

Learning outcome	% of Students agreeing
Better understanding of the material	85%
Increased motivation	78%
Development of spatial thinking	90%
Facilitation of project work	72%

Moreover, 90% of students identified improvements in spatial reasoning, a critical competence for problem-solving in STEM disciplines, while 72% acknowledged that the platform simplified project-based tasks, thereby supporting the development of critical thinking, creativity, and collaborative skills (Figure 8). Collectively, these findings emphasize the transformative potential of digital 3D modeling tools in fostering higher-order cognitive skills and enhancing the overall quality of contemporary learning experiences.

Figure 8
Students Perception of Sketchfab Impact



Conclusions

The analysis of Sketchfab usage in the educational environment demonstrates a steady increase in adoption among both teachers and students, highlighting the growing role of 3D visualization technologies in contemporary pedagogical practices. The observed rise in the number of users underscores the platform's relevance in facilitating immersive, interactive, and student-centered learning experiences.

The integration of Sketchfab into the instructional process serves multiple pedagogical functions, including enhancing spatial cognition, supporting interdisciplinary project-based learning, and fostering digital literacy. The data reveal that educators primarily utilize the platform for the visualization of complex three-dimensional models, which contributes to cognitive load reduction and improved conceptual understanding, particularly in STEM

disciplines. Simultaneously, students engage with Sketchfab not only for academic purposes but also for self-directed learning and creative exploration, reflecting the shift towards constructivist and inquiry-based learning paradigms.

The increase in weekly usage hours among students compared to teachers suggests a higher degree of learner autonomy and motivation in interacting with 3D content. This trend aligns with contemporary educational frameworks emphasizing active learning, digital fluency, and the development of metacognitive skills. Furthermore, survey results indicate that students perceive Sketchfab as a valuable tool for improving learning outcomes, particularly in terms of knowledge retention, problem-solving abilities, and overall academic engagement.

From a methodological perspective, the findings suggest that the effective integration of 3D visualization tools into curricula requires well-structured pedagogical strategies that align with competency-based education and differentiated instruction principles. Educators should be equipped with adequate training and methodological guidelines to maximize the didactic potential of such technologies. Additionally, institutional support in terms of technological infrastructure and curriculum adaptation is essential to ensure the sustainability of digital learning innovations.

Given the accelerating digital transformation in education, further research should explore the long-term impact of immersive visualization tools on cognitive development, knowledge acquisition, and student motivation. Future studies should also examine best practices for implementing 3D technologies in hybrid and distance learning settings to enhance accessibility and inclusivity in education.

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