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

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***Abstract*—This paper explores the potential of Sketchfab as a tool for visualizing technical processes in the educational environment, focusing on its application in STEM and technology education. The research examines how the platform's 3D modeling and visualization capabilities can enhance learning outcomes by fostering a better understanding of complex technical concepts and improving spatial reasoning. The study is grounded in the context of the increasing digitalization of education and the integration of immersive technologies in teaching practices. The research employs a mixed-methods approach, combining quantitative analysis of user engagement statistics with qualitative interviews and surveys conducted with both teachers and students. Statistical data were collected on the number of users, their purposes for using Sketchfab, and the time spent engaging with the platform. Additionally, perceptions of Sketchfab's impact on learning outcomes were assessed, focusing on its role in enhancing student motivation, improving understanding of technical content, and developing spatial thinking. Results indicate a significant increase in the adoption of Sketchfab among educators and learners between 2023 and 2024, with teacher usage rising by 40% and student engagement growing by 37.5%. The platform is primarily utilized for visualizing 3D models, facilitating project-based learning, and enhancing laboratory work. Students reported a high level of satisfaction, with 85% agreeing that Sketchfab improved their understanding of complex subjects and 90% indicating that it contributed to the development of their spatial thinking. The findings suggest that Sketchfab offers valuable pedagogical benefits, particularly in technical and STEM education. By providing an interactive, immersive learning experience, it enables students to visualize abstract concepts and engage in hands-on learning, thus supporting constructivist approaches to education. The platform's integration into instructional design not only enriches content delivery but also fosters a student-centered learning environment. In conclusion, Sketchfab represents a promising tool for the visualization of technical processes in education. However, its full potential requires further exploration through long-term studies and the development of methodological guidelines for its effective use in various educational settings. Recommendations for educators include incorporating 3D modeling as a central element in project-based learning and utilizing Sketchfab to facilitate collaborative problem-solving tasks.**

Keywords*— *Sketchfab, 3D visualization, technical processes, educational technology.

I. INTRODUCTION

In the modern educational environment, significant attention is being paid to the integration of advanced digital technologies, particularly virtual 3D models, to enhance the quality of the learning process. One such tool

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is Sketchfab — a platform for creating and viewing 3D models online, which has the potential to fundamentally change the approach to visualizing technical processes in educational institutions [1]. Specifically, Sketchfab offers opportunities for more visual and interactive learning, which is crucial in the context of technical education.

Given the martial law situation in Ukraine and the significant challenges faced by the educational process, virtual technologies have become especially relevant [2]. They allow for the continuity of education by providing access to modern educational resources, even with limited physical interaction and resources [3]. In particular, Sketchfab can serve as a powerful tool for studying technical disciplines, as the platform enables the modeling and visualization of complex technical processes, thereby promoting a deeper understanding of both theoretical and practical aspects of the learning material [4].

The relevance of this study lies in the need to adapt the educational process to new realities, especially in conditions where traditional teaching methods may be complicated due to restrictions imposed by military actions [5]. Considering the specifics of using such technologies for visualizing technical processes will increase learning effectiveness and maintain a high level of educational standards, even under extraordinary circumstances [3].

Research conducted by scholars analyzing alternative platforms confirms that traditional tools such as Autodesk Fusion 360, Blender, and Unity, while offering advanced modeling and simulation capabilities, often require high computational resources, which can hinder their application in contexts with limited access to powerful hardware [7]-[8]. Given the current challenges in digital education, particularly in regions affected by crises, the accessibility and adaptability of educational technologies play a crucial role in ensuring uninterrupted learning.

International educational institutions have demonstrated that web-based platforms with integrated collaborative functionalities and mobile adaptability are the most effective solutions during periods of educational disruption [9]. Unlike desktop-based modeling software, which may present technical barriers due to installation requirements and hardware dependency, Sketchfab provides a scalable, user-friendly, and cloud-based alternative that facilitates seamless access to 3D visualization tools across multiple devices.

From a pedagogical perspective, Sketchfab aligns with modern constructivist approaches by supporting interactive, experiential, and competency-based learning [10]. The platform enables real-time collaboration, fostering student engagement, problem-solving skills, and spatial cognition—key competencies in STEM and technical education. Moreover, its intuitive interface and cross-platform compatibility make it an ideal tool for blended learning environments, allowing both educators and learners to engage with immersive educational content without technical constraints [11].

Thus, the aim of this article is to explore the potential of using Sketchfab to visualize technical processes in the educational environment, taking into account the challenges arising from the martial law situation in Ukraine.

To develop modern education in Ukraine, it is important not only to conduct theoretical research but also to implement practical studies that promote the activation of independent, creative, and innovative thinking among engineers. The use of innovative technologies such as 3D modeling in the educational process, when applied correctly, allows for the significant expansion of engineers' worldviews, enhances their cognitive activity, and contributes to the formation of general scientific competencies [14]. Specifically, the application of the Sketchfab program for visualizing technical processes enables engineers to study object modeling and create interactive 3D models at different training stages. However, there is still a need to improve the educational and methodological support that would facilitate the effective integration of this tool into the educational process [17]. The aim of this article is to analyze the possibilities of using the Sketchfab program for teaching the creation of 3D models of various objects and to highlight existing problems and potential solutions for ensuring high-quality training in the educational environment of Ukraine.

II. Materials and Methods

The research was conducted at Poltava State Agrarian University among students majoring in Agroengineering, within the framework of philological and engineering disciplines, and at Berdiansk State Pedagogical University in the context of teaching the courses «Fundamentals of Engineering and Pedagogical Creativity» and «Engineering and Computer Graphics». The aim of the study was to evaluate the pedagogical effectiveness of Sketchfab as an innovative digital tool for improving the visualisation of technical processes in engineering education. A mixed-methods research design was applied, combining quantitative analysis of user experience metrics with qualitative assessments of cognitive activity and didactic perception among students and teachers.

Various methods were used to collect data. The analysis of user engagement was based on the analytics of the Sketchfab platform. The study tracked user activity, session duration, and interaction with educational content during the 2023-2024 academic year. To evaluate the effectiveness of Sketchfab in improving technical visualisation, problem-based learning (PBL) and digital literacy, structured surveys were conducted among 150 students of the Agroengineering programme at Poltava State Agrarian University and 30 teachers from Poltava State Agrarian University, V. G. Korolenko Poltava National Pedagogical University and Berdiansk State Pedagogical University. Among them, 100 students and 20 teachers were from Poltava State Agrarian University, while 50 students and 10 teachers were from Berdyansk Pedagogical University. This distribution allowed for a comparative analysis of Sketchfab’s effectiveness in

different educational contexts, considering both agricultural and pedagogical perspectives. Semi-structured interviews were also conducted with 20 students and 10 teachers from all three universities to gain a deeper understanding of the integration of 3D modelling tools into the curriculum and their impact on competency-based learning and cognitive development. The interviews were conducted in a guided discussion format (online via Zoom and in person at the universities), which allowed participants to discuss pre-defined topics and also provided an opportunity to express additional ideas. The questions focused on the effectiveness of Sketchfab in improving technical visualisation, problem-solving skills, spatial cognition, and its impact on student motivation and engagement.

Content analysis of the responses to the open-ended questionnaire and interview transcripts was conducted using thematic coding to identify recurring patterns and pedagogical insights.

A combination of descriptive and inferential statistics was used to process and analyse the data using SPSS software to examine learning outcomes. NVivo software was used for qualitative thematic analysis. The study followed a structured procedural design. The first stage was data collection, which took place from September 2023 to May 2024. During this stage, Sketchfab was actively used in laboratory and theoretical coursework. The next stage of data analysis (June-August 2024) included triangulation of the results to ensure validity and reliability, as well as to identify best practices for implementing 3D modelling technologies in agricultural engineering education.

A range of digital learning tools supported the study, including Sketchfab and online learning management systems (LMS). Surveys were distributed via Google Forms, and structured interview guides facilitated data collection. Theoretical analysis was conducted at Poltava V.G. Korolenko National Pedagogical University to contextualize the findings within broader trends of digitalization in education and the integration of immersive learning technologies. Primary statistical processing and data generalization were applied to analyze survey responses and engagement indicators, ensuring reliable and interpretable results.

III. Results and Discussion

The role and significance of visualization technologies in the educational process were analyzed, along with the possibilities of studying 3D modeling in engineering education. The study also examined the specifics of modeling three-dimensional objects using the Sketchfab platform for visualizing technical processes in an educational environment, considering the state of martial law in Ukraine. The research is based on the analysis of current trends in digital technologies and their impact on the educational process, particularly on the development of technical competencies among engineers in conditions of limited resources and a challenging security situation.

To achieve the set objectives, a review of scientific works related to the use of 3D modeling and virtual reality in teaching technical disciplines was conducted. Special attention was given to studies that address the adaptation of educational processes during a military conflict and war. The research also included the practical implementation of virtual 3D models created on the Sketchfab platform in technical discipline classes for secondary school students and engineering students. The models featured technical processes, mechanisms, and technologies that demonstrate the practical application of theoretical knowledge.

A content analysis of materials on the Sketchfab platform was also carried out to assess their potential in the context of Ukrainian educational requirements and adaptation to the realities of martial law. The analysis included studying the available models, their quality, the presence of instructions, and their alignment with educational objectives. Furthermore, the effectiveness of traditional methods for teaching technical processes was compared with the use of digital 3D models, which helped identify the advantages and disadvantages of each approach under contemporary challenges.

Overall, the research methods allow for a deeper understanding of the potential of Sketchfab as a tool for visualizing complex technical processes in the educational environment and evaluating its significance in times of emergency and war, where it is crucial to maintain the quality of education even under resource constraints.

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 (Fig.1.). 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%.

This upward trend suggests a growing recognition of the pedagogical affordances of Sketchfab in enhancing digital literacy, facilitating immersive learning experiences, and fostering interdisciplinary approaches to education. The increased adoption among teachers highlights the platform's integration into instructional design, particularly in STEM education, where three-dimensional visualization aids cognitive load management and spatial reasoning development.

The significant rise in student engagement indicates a shift towards more interactive and constructivist learning paradigms, wherein learners actively explore, manipulate, and analyze 3D content to construct knowledge. This aligns with contemporary pedagogical frameworks emphasizing experiential learning, multimodal representations of information, and student-centered methodologies.

The growth in Sketchfab adoption may also be attributed to the increasing digitalization of education, the need for remote and blended learning solutions, and the rising demand for immersive educational technologies. These findings underscore the necessity for further research into the impact of 3D visualization tools on learning outcomes, as well as the development of best practices for their effective pedagogical integration.

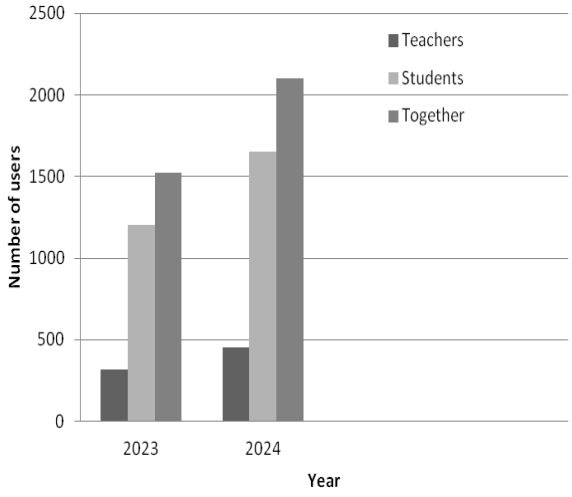

Fig. 1. Number of Sketchfab users among teachers and students.

The analysis of the obtained data indicates the widespread use of Sketchfab in the educational process, driven by its high potential for visualizing learning materials and enhancing project-based learning (Fig.2).

According to the results, the primary purpose of Sketchfab usage among educators is the visualization of 3D models (60%), highlighting a strong orientation of the educational process towards augmented and virtual reality technologies. This contributes to the development of both subject-specific and interdisciplinary competencies. The use of virtual models ensures the visualization of complex technical and scientific concepts, which is a crucial factor in facilitating their comprehension.

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.

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

The least common use of Sketchfab is for laboratory work (5% among students and 10% among educators). This may indicate that integrating 3D models into laboratory activities requires additional pedagogical scaffolding or specialized technical equipment.

Overall, the analyzed results confirm that the integration of digital tools, particularly Sketchfab, fosters the development of digital literacy, supports the implementation of STEM education principles, and enhances cognitive engagement through interactive learning methods. Optimizing pedagogical strategies with virtual technologies can improve the effectiveness of the learning process and align it with the demands of the modern educational environment.

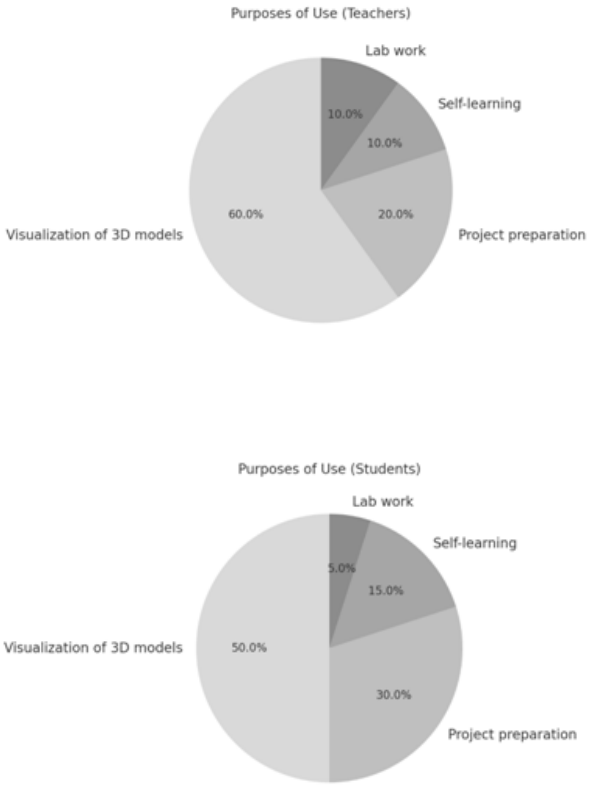

Fig. 2. Purpose of using Sketchfab in the learning process.

Research data indicate the active use of the platform by both instructors and students. The average time spent by instructors on Sketchfab is 3.5 hours per week, suggesting that they are integrating this platform into the learning process, particularly for visualizing and creating 3D models that can be applied across various subject areas. In contrast, students spend more time on Sketchfab (5.2 hours per week), which reflects high levels of interest and engagement in their learning activities. This level of engagement highlights the potential of this technology to foster cognitive skills, particularly spatial thinking, imagination, and independent learning. The overall average usage (4.3 hours per week) reflects a growing trend toward interactive learning, which aligns with contemporary pedagogical approaches to integrating digital tools into the educational process.

The results from the student survey presented in Table 1 clearly indicate a positive impact of using Sketchfab on their learning outcomes. Specifically, 85% of students reported that the platform helps them better understand the learning material. This underscores the

effectiveness of visualizing complex concepts through 3D models, which is crucial for deepening understanding and knowledge acquisition in demanding academic disciplines. 78% of students noted an increase in motivation to learn, highlighting the significant role of interactive and visual technologies in stimulating interest in the learning process. Moreover, 90% of students recognized improvements in their spatial thinking, which is a key competence for solving problems in technical and natural sciences. Additionally, 72% of students reported that the platform made working on projects easier, supporting the development of critical thinking and creativity during project-based work.

TABLE 1 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%

In conclusion, the analysis of both tables suggests a high level of integration of Sketchfab into the learning process, positively influencing educational outcomes. The increase in platform usage time and the high percentage of positive feedback from students confirm the significance of this technology in developing modern competencies such as spatial thinking, autonomy, creativity, and motivation for learning. Given these results, it is recommended to further integrate Sketchfab into educational programs to foster the development of digital and cognitive skills among students.

The research findings indicate the active utilization of the platform by both educators and students. The average time instructors spend on Sketchfab is 3.5 hours per week, demonstrating its integration into the instructional process, particularly for the visualization and development of 3D models applicable across various subject domains. Conversely, students allocate more time to Sketchfab (5.2 hours per week), reflecting a high level of engagement and intrinsic motivation in their learning activities. This degree of involvement underscores the potential of this technology in fostering cognitive skills, particularly spatial reasoning, imagination, and self-directed learning. The overall average usage (4.3 hours per week) highlights a growing shift toward interactive learning, aligning with contemporary pedagogical frameworks that emphasize the integration of digital tools into the educational environment.

IV. 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 underscore the necessity of structured pedagogical strategies for the successful integration of 3D visualization tools into competency-based education. Effective implementation requires that educators receive specialized training and methodological support to maximize the didactic potential of immersive technologies. Moreover, institutional investment in digital infrastructure and curriculum adaptation is crucial for ensuring the sustainability and scalability of digital learning innovations.

Despite these promising results, the study has several limitations. The research primarily focuses on short-term adoption trends, necessitating further investigation into the long-term cognitive effects of immersive visualization technologies. Additionally, while this study examines user perceptions and engagement patterns, future research should employ experimental and longitudinal designs to assess the direct impact of 3D visualization tools on learning outcomes, skill development, and cognitive load reduction. The generalizability of findings is also limited to the specific context of agroengineering education, warranting further exploration of discipline-specific applications in other STEM fields.

As digital transformation in education accelerates, future research should explore scalability, accessibility, and inclusivity in implementing immersive visualization tools in hybrid and distance learning environments. Investigating best practices for integrating 3D modeling into STEM curricula and examining its role in fostering

critical thinking, collaborative learning, and interdisciplinary approaches would provide valuable insights. Additionally, exploring the potential of AI-driven 3D modeling and augmented reality (AR) integration could further expand the pedagogical applications of immersive learning technologies in agroengineering and related technical disciplines. Future studies should also examine the interaction between immersive visualization tools and adaptive learning technologies**,** exploring how AI-driven recommendations and personalized learning pathways can enhance student engagement and knowledge retention. Furthermore, comparative research across different educational institutions and geographic regions could provide insights into contextual factors influencing adoption rates and effectiveness**.**

Another crucial direction for further research involves assessing the cost-effectiveness and return on investment of integrating 3D visualization tools in higher education, particularly in resource-constrained settings. Understanding the institutional and infrastructural challenges associated with large-scale implementation would help policymakers and educational administrators make informed decisions about the sustainability of digital learning initiatives**.**

Lastly, as digital education continues to evolve, interdisciplinary research collaborations between educators, cognitive scientists, and technology developers could lead to the creation of more interactive, AI-enhanced, and pedagogically optimized 3D learning environments**.** Investigating the potential of virtual reality (VR) and mixed reality (MR) extensions of Sketchfab could provide a more immersive and experiential approach to agroengineering education, further bridging the gap between theoretical knowledge and hands-on technical skills development**.**

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Furthermore, we acknowledge the academic community's contributions in developing of interdisciplinary methodologies that enhance student engagement and cognitive development through innovative digital tools. The increasing adoption of 3D visualization platforms in education underscores the relevance of ongoing research in the field, and the author acknowledges the invaluable contributions of those advancing the discourse on interactive and multimodal learning environments.

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