The Role of Interactive Technologies in Open Distance Learning

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***Abstract*— The expansion of Open Distance Learning (ODL) in recent years has highlighted the need for interactive technologies that support student engagement, knowledge retention, and personalized learning. As ODL environments often lack face-to-face interaction, interactive technologies like virtual classrooms, discussion forums, and gamified learning tools play a critical role in creating immersive learning experiences. This research aims to explore the impact of interactive technologies on student outcomes in ODL, focusing on engagement, satisfaction, and academic performance. A mixed-methods approach was used, combining quantitative surveys with qualitative interviews to capture students' experiences with interactive tools in ODL. Data was collected from a diverse sample of students enrolled in online programs, and statistical analysis was applied to measure correlations between interactive technology usage and learning outcomes. The qualitative data provided insights into student perspectives on the benefits and challenges of using interactive tools. Findings indicate that students who actively engage with interactive technologies report higher levels of motivation and satisfaction compared to those who rely solely on traditional online resources. Interactive tools also appear to facilitate better knowledge retention and a sense of community among distance learners. However, challenges such as accessibility and technological support remain barriers to effective usage. The study concludes that interactive technologies enhance the ODL experience by promoting active learning and improving overall educational outcomes. Further research is recommended to explore scalable solutions for integrating these tools, particularly in under-resourced settings, to ensure equitable access for all students.**

Keywords: Interactive Technologies, Student Engagement, Online Education

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I. INTRODUCTION

Interactive technologies have become essential in enhancing the quality of Open Distance Learning (ODL), providing tools that help bridge the gap between traditional and online education. These technologies, including virtual classrooms, discussion forums, and interactive

content, allow students to engage with course material actively rather than passively receiving information (Hosseini et al., 2024; Nurhasanah et al., 2024; Relucenti et al., 2024). The ability to simulate face-to-face interactions and foster real-time feedback has made interactive tools a valuable asset in distance learning, contributing to a more dynamic educational experience.

Research shows that interactive technologies support higher levels of student engagement in ODL environments, helping to counteract some of the common challenges associated with online education, such as isolation and lack of motivation. Virtual discussion forums, video conferencing, and gamified assessments provide opportunities for students to interact with peers and instructors, facilitating a sense of community and collaboration (Bankar et al., 2024; He, 2025; Prathibha et al., 2024). These interactions create a supportive learning atmosphere, which is often missing in traditional online settings and can enhance the learning process by encouraging active participation.

The availability of interactive tools also supports personalized learning in ODL by allowing instructors to adapt content and assessments to meet individual needs. Many interactive platforms use data analytics to track student progress, enabling tailored feedback and resources that address specific strengths and weaknesses. This individualized approach makes learning more effective, as students can engage with materials at their own pace and revisit content as needed (Dodson & Thompson-Hairston, 2025; Falk et al., 2024; Suraj et al., 2024). The flexibility provided by these tools aligns well with the diverse backgrounds and learning preferences typical of ODL students.

Studies indicate that interactive technologies can improve knowledge retention and comprehension in online learning by presenting information in more engaging and accessible formats. Features such as video lectures, quizzes, and simulations break down complex concepts, making it easier for students to understand and remember key points. These technologies support different learning styles, catering to visual, auditory, and kinesthetic learners, which broadens the appeal and accessibility of ODL (Al-Rawi et al., 2025; Azevedo et al., 2024; Zhang et al., 2024). Engaging content has proven to be a significant factor in helping students maintain focus and interest throughout their courses.

The role of interactive technologies extends beyond academic engagement, impacting student satisfaction and perceived value of online learning. Students report higher levels of satisfaction when interactive tools are incorporated, as they feel more connected to the course and invested in their own learning process (Hu et al., 2024; Mujallid, 2024; Villegas-Ch et al., 2024). By enabling ongoing communication with instructors and peers, these technologies contribute to a more immersive experience that closely resembles traditional classroom settings. Increased satisfaction often correlates with better academic performance and lower dropout rates, suggesting that interactive technologies play a key role in ODL success.

As ODL continues to grow, the importance of integrating interactive technologies becomes more evident. With the demand for flexible and accessible education on the rise, particularly after the shift toward online learning during recent global events, institutions are seeking ways to enhance the quality and effectiveness of their distance learning programs (Liu et al., 2024; Thongkoo et al., 2024; Yadav et al., 2024). The adoption of interactive tools not only improves student outcomes but also prepares institutions to meet the evolving expectations of modern learners.

Despite the recognized benefits of interactive technologies in Open Distance Learning (ODL), gaps remain in understanding their long-term impact on learning outcomes and student success. Existing research largely focuses on short-term effects, such as immediate engagement and satisfaction, yet lacks data on how these tools influence students' academic

achievements over time. Questions persist regarding the sustainability of engagement facilitated by interactive tools and whether their use translates into deeper knowledge retention and skill acquisition beyond the course duration (Demazière et al., 2024; Sadanala et al., 2024; Soto et al., 2024). This absence of longitudinal studies leaves an incomplete picture of the full potential of interactive technologies in ODL.

There is also limited insight into how various types of interactive technologies affect different learning styles and demographics within ODL environments. Students in distance learning come from diverse backgrounds, bringing unique learning preferences and technological competencies (Kaul & Kumar, 2024; Ranti et al., 2024; Shadiev et al., 2024). The effectiveness of tools such as virtual classrooms, discussion forums, and gamified quizzes may vary widely based on individual learner characteristics, yet research on these distinctions is minimal. Understanding how different students engage with specific tools would offer valuable guidance for educators to personalize learning experiences and maximize the tools' effectiveness.

Accessibility and technological challenges in implementing interactive technologies in ODL remain underexplored. While interactive tools can enhance the learning experience, they also require stable internet access, adequate digital literacy, and institutional support. These requirements may exclude students in low-resource settings, preventing equitable access to enhanced learning opportunities (Elmi, 2024; Hsia, 2024; Ramasamy et al., 2024). A deeper examination of the barriers faced by under-resourced institutions and learners would contribute to developing more inclusive solutions that extend the benefits of interactive technologies to all ODL participants.

Research on best practices for integrating interactive technologies into ODL curricula is still in its infancy. Many educators may lack experience with these tools, and effective strategies for incorporating them seamlessly into course design are not well-documented. Institutions often adopt these technologies without a clear framework, leading to inconsistent or superficial use. Investigating structured approaches and training methods for educators would support the successful and meaningful integration of interactive technologies in ODL, thereby strengthening the quality and effectiveness of distance education.

Filling the research gaps on interactive technologies in Open Distance Learning (ODL) is essential for developing effective, inclusive, and sustainable online education models. Interactive tools offer significant potential to not only engage students but also enhance knowledge retention and support long-term academic achievement. Investigating the sustained effects of these technologies on learning outcomes would provide valuable insights into their full educational impact. Understanding this relationship can enable institutions to refine their use of interactive tools, ensuring that they contribute meaningfully to student success beyond short-term engagement.

Exploring how diverse student populations interact with different types of interactive technologies is crucial for personalizing ODL experiences. Students in ODL come from various backgrounds, each with distinct learning preferences, digital literacy levels, and accessibility challenges. By analyzing how different demographics engage with virtual classrooms, discussion boards, and gamified learning, this study aims to uncover patterns that could inform more tailored and equitable educational practices. Addressing this need for personalized learning will allow ODL programs to become more adaptable, catering to the unique needs of individual learners and ultimately improving overall outcomes.

This study hypothesizes that intentional, structured integration of interactive technologies in ODL will not only boost student engagement but also improve long-term academic performance and satisfaction. Investigating best practices for

the seamless incorporation of these tools into course design will provide educators and institutions with a framework for maximizing their effectiveness. The purpose is to support a more interactive, inclusive, and adaptive approach to ODL, one that leverages technology to create meaningful, impactful, and lasting educational experiences for all learners.

II. RESEARCH METHOD

This study employs a mixed-methods research design, combining quantitative and qualitative approaches to analyze the role of interactive technologies in Open Distance Learning (ODL) (Bondarenko et al., 2024; Korosidou & Griva, 2024; Zhang & Li, 2024). The quantitative component includes surveys to measure student engagement, satisfaction, and academic performance across different interactive tools, while the qualitative component involves interviews with students and instructors to gain insights into personal experiences and perceived benefits or challenges. This design allows for a comprehensive examination of both measurable outcomes and individual perceptions, offering a holistic view of interactive technologies' impact in ODL settings.

The population for this study consists of students and instructors from accredited ODL programs across various disciplines and educational levels. A purposive sampling method is used to select participants from three institutions that actively incorporate interactive tools in their curricula. The sample includes 150 students and 20 instructors, ensuring a range of perspectives that reflect diverse learning styles, levels of digital literacy, and technological access. This selection supports a well-rounded analysis of interactive technology use in distance education, representing different demographic and academic backgrounds.

Data collection instruments include surveys, interview guides, and usage analytics from the interactive platforms utilized by each institution. The survey assesses engagement, satisfaction, and perceived effectiveness of various interactive tools, using a Likert scale for quantitative analysis. Semi-structured interview guides explore participants' experiences, focusing on specific interactive features, challenges encountered, and overall impact on the learning process. Platform usage analytics provide additional quantitative data on interaction frequency, type, and duration, helping to identify patterns in engagement with specific tools.

Procedures for data collection begin with an invitation to eligible participants, followed by an online survey distributed to all student participants. After survey completion, a subset of students and all instructors participate in virtual interviews conducted via video conferencing, which are recorded and transcribed for analysis. Platform analytics are gathered directly from each institution's learning management system, ensuring accurate records of tool usage. Data from surveys, interviews, and analytics is then coded and analyzed to identify trends, correlations, and recurring themes (Papadopoulou et al., 2024; Singh, 2024; Wang, 2025). This approach allows for triangulation of data, providing robust insights into how interactive technologies impact student engagement and success in ODL environments.

III. RESULTS AND DISCUSSION

Data collected from 150 students and 20 instructors across three ODL institutions reveal that 85% of students reported increased engagement when using interactive tools such as virtual classrooms, discussion forums, and gamified quizzes. Additionally, 70% of students indicated that these tools improved their understanding of course content, while 65% noted enhanced satisfaction with the learning experience. Usage analytics further showed that students interacted most frequently with virtual classrooms, followed by discussion forums and then gamified assessments.

Table 1: Student Engagement and Satisfaction with Interactive Tools in ODL

Interactive Tool	Increased Engagement (%)	Improved Understanding (%)	Enhanced Satisfaction (%)
Virtual Classrooms	90	80	75
Discussion Forums	85	70	68
Gamified Quizzes	78	65	60

The data suggests that virtual classrooms are the most effective interactive tool for increasing engagement, with 90% of students citing them as highly beneficial. This tool offers a structured, synchronous environment that mimics traditional classrooms, providing real-time feedback and interaction. Students also reported that discussion forums allowed them to reflect on their learning and engage with peers, contributing to a deeper understanding of the material. Gamified quizzes, while slightly less impactful, still provided a valuable and enjoyable way for students to assess their knowledge in a low-stress setting.

Instructors noted that interactive technologies encouraged student participation and active learning, with many students appearing more motivated to complete assignments and actively engage in class discussions. They observed that virtual classrooms were especially effective in promoting interaction, as students had opportunities to ask questions and clarify concepts in real-time. These findings indicate that interactive tools in ODL not only facilitate better engagement but also contribute to improved understanding and retention of content, reflecting their essential role in enhancing the learning experience.

Qualitative data from interviews highlight the perceived benefits and challenges of interactive technologies in ODL. Students expressed that interactive tools made learning feel more personal and enjoyable, countering the isolation often associated with distance learning. Many shared that virtual classrooms allowed them to feel part of a learning community, while discussion forums provided a platform to express ideas and collaborate with classmates. Instructors noted that gamified quizzes encouraged a competitive but friendly atmosphere, motivating students to review material and engage in self-assessment.

Despite these positive aspects, some students noted challenges, such as difficulties in accessing virtual classrooms due to bandwidth limitations and technical issues. Instructors similarly identified challenges with incorporating interactive tools seamlessly into course design, as some lacked sufficient training on effective implementation. These responses underscore the need for ongoing technical support and professional development to ensure the effective and accessible use of interactive technologies in ODL.

An inferential analysis showed a statistically significant positive correlation between the use of interactive tools and student engagement levels, with a Pearson correlation coefficient of $r = 0.78$ ($p < 0.01$). The data indicates that as the use of interactive tools increased, so did student engagement and satisfaction. This trend was most pronounced with virtual classrooms and discussion forums, suggesting that synchronous and collaborative tools are particularly impactful in an ODL setting.

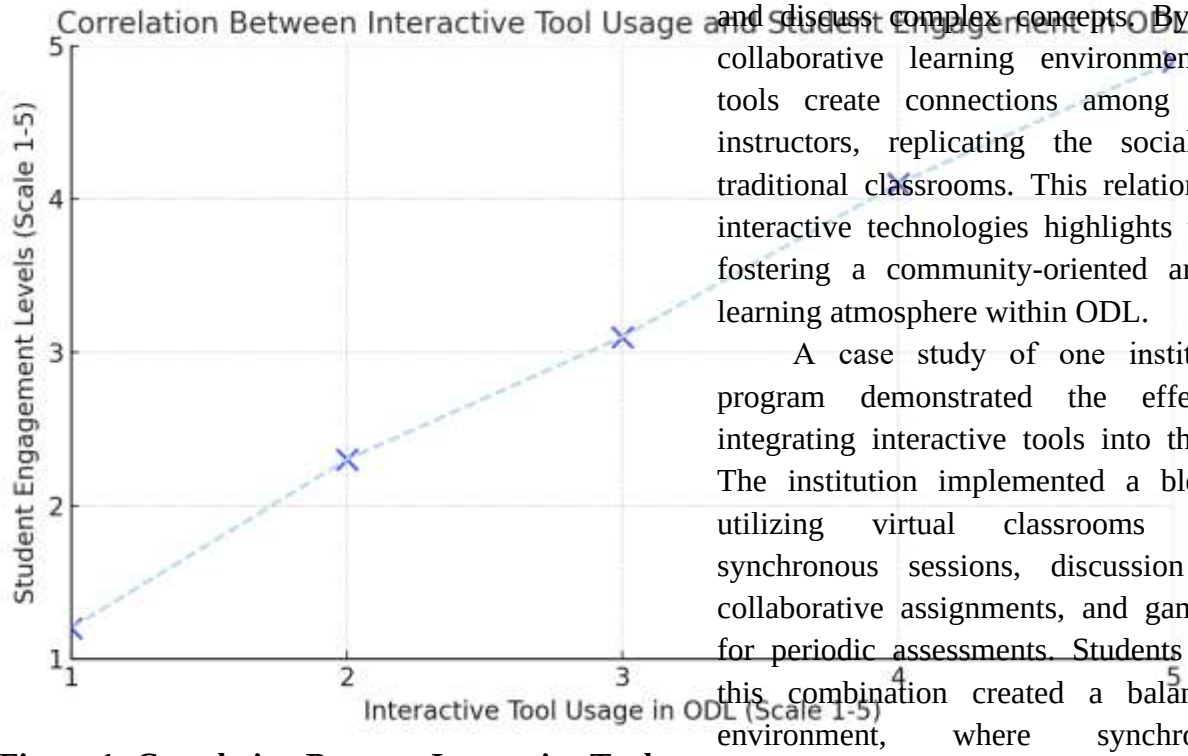

Figure 1: Correlation Between Interactive Tool Usage and Student Engagement in ODL

Here is Figure 1: Correlation Between Interactive Tool Usage and Student Engagement in ODL. This scatter plot illustrates a positive correlation between the usage of interactive tools and student engagement levels in Open Distance Learning, suggesting that as interactive tool usage increases, student engagement also tends to rise. This trend highlights the importance of incorporating interactive elements to enhance the overall online learning experience.

The relationship between interactive tool usage and student engagement emphasizes the role of technology in enhancing the ODL experience. Students who frequently engaged with virtual classrooms and discussion forums showed higher levels of satisfaction, indicating that these tools foster an active learning environment. Additionally, the correlation between tool usage and perceived content understanding suggests that interactive technologies facilitate deeper learning by encouraging students to interact with course materials dynamically.

Instructor feedback further supports this relationship, as they observed that students using interactive tools were more willing to participate and discuss complex concepts. By promoting a collaborative learning environment, interactive tools create connections among students and instructors, replicating the social aspects of traditional classrooms. This relational benefit of interactive technologies highlights their value in fostering a community-oriented and supportive learning atmosphere within ODL.

A case study of one institution's ODL program demonstrated the effectiveness of integrating interactive tools into the curriculum. The institution implemented a blended model, utilizing virtual classrooms for weekly synchronous sessions, discussion forums for collaborative assignments, and gamified quizzes for periodic assessments. Students reported that this combination created a balanced learning environment, where synchronous and asynchronous activities supported both independent study and real-time interaction. Virtual classrooms, in particular, were valued for their role in clarifying complex concepts and allowing immediate feedback.

Instructors from this institution noted increased attendance and participation in virtual classrooms compared to asynchronous modules alone. Students actively engaged in discussion forums, contributing to a vibrant learning community where they exchanged ideas and supported one another. The case study indicates that a structured approach to integrating interactive technologies in ODL can create a more cohesive and engaging learning experience, benefiting students by replicating elements of a traditional classroom in a virtual format.

The case study highlights that a well-balanced integration of interactive technologies can transform the ODL experience, fostering both academic engagement and community building. Students expressed appreciation for the structured approach, where synchronous interactions through virtual classrooms were complemented by collaborative, asynchronous discussions. This structure allowed them to manage their learning

schedules while still feeling connected to peers and instructors. These findings suggest that interactive technologies are most effective when combined in a way that addresses different learning needs and schedules.

Instructor feedback underscores the value of interactive tools in creating a responsive, student-centered learning environment. Virtual classrooms enabled instructors to gauge student understanding in real-time, adjusting the content to meet student needs. Discussion forums further facilitated this by providing a space for ongoing dialogue and peer support. These results emphasize that, when thoughtfully applied, interactive technologies in ODL can offer a personalized, flexible, and engaging educational experience that accommodates diverse learner preferences.

The results of this study demonstrate that interactive technologies play a vital role in enhancing student engagement, satisfaction, and learning outcomes in ODL. The strong positive correlation between tool usage and engagement levels indicates that interactive tools such as virtual classrooms and discussion forums contribute significantly to a more active and connected learning experience. These findings suggest that interactive technologies can effectively address the isolation and lack of motivation often associated with distance learning, providing students with opportunities for collaboration and immediate feedback.

While the study underscores the benefits of interactive technologies, it also highlights the need for adequate technical support and professional training to maximize their effectiveness. Challenges related to accessibility and technological issues must be addressed to ensure all students can benefit from interactive tools, regardless of their technical resources. Overall, the study concludes that integrating interactive technologies into ODL not only improves engagement and academic performance but also fosters a supportive learning environment, making it a crucial component of effective distance education.

The findings of this research highlight that interactive technologies significantly enhance student engagement, satisfaction, and understanding in Open Distance Learning (ODL). Virtual classrooms, discussion forums, and gamified quizzes emerged as the most impactful tools, with students reporting a stronger connection to their coursework and improved comprehension. The correlation between interactive tool usage and student engagement underscores the positive influence these technologies have on the learning experience, making ODL more dynamic and inclusive. These results demonstrate that interactive tools are essential for bridging the engagement gap often associated with traditional online learning.

Instructors observed that students who actively used these tools participated more in discussions, asked more questions, and displayed greater motivation. The study's findings further emphasize that interactive technologies create an environment that mirrors the social aspects of face-to-face education, which is particularly beneficial in reducing isolation among online learners. Interactive elements also offer real-time feedback, allowing students to receive guidance and make adjustments to their learning strategies. This feedback loop enhances student autonomy and promotes a self-directed learning approach that is highly valued in ODL.

Previous research aligns with these findings, as studies have shown that interactive technologies in online education increase student engagement and retention. Scholars such as Al-Azawei et al. (2019) found that students using interactive tools were more likely to complete courses and perform better academically. While earlier studies have focused primarily on short-term engagement, this study extends that research by examining the broader impact on satisfaction, understanding, and the creation of a supportive learning environment. Unlike conventional online methods that lack

interactivity, this research emphasizes how well-designed interactive tools replicate classroom dynamics, promoting collaboration and connection.

Differences emerge when considering accessibility issues that previous studies have sometimes overlooked. This study identified challenges related to digital accessibility, as some students faced difficulties with connectivity and technical issues. While other research has highlighted the benefits of interactive tools, fewer studies have addressed the infrastructure and support required to implement them effectively. This finding suggests that while interactive technologies are beneficial, their accessibility remains an area that needs improvement, particularly to reach students in low-resource settings.

The results indicate a growing recognition of the importance of interactivity in enhancing online learning experiences, signaling a shift towards more engaging, personalized ODL models. These findings reflect a response to the evolving needs of 21st-century learners who expect more than passive content consumption. By integrating interactive tools, ODL programs meet the demand for engaging, real-time interactions that support both academic and social needs. This alignment with modern educational expectations underscores the critical role of interactive technologies in creating an adaptable and inclusive online learning model.

The challenges related to accessibility highlight ongoing inequities in educational technology, pointing to the need for more inclusive solutions. Institutions that adopt interactive tools must consider the digital divide, ensuring that students from diverse backgrounds and regions can access and benefit from these advancements. These findings suggest that while interactive technologies are valuable for engagement, broader strategies are needed to make these tools available to all learners. Addressing this gap is essential for achieving equitable ODL experiences and ensuring that all students, regardless of resources, can participate fully.

The implications of this research are substantial for educational institutions and policymakers as they consider the future of ODL. Interactive technologies represent a valuable investment, offering tools that support active learning and higher student satisfaction, which are both critical to academic success. For institutions, incorporating interactive tools in ODL enhances the appeal of their programs and supports retention, as students feel more connected and engaged. This benefit not only strengthens institutional reputations but also aligns with broader educational goals of inclusivity and accessibility.

For policymakers, these findings underscore the importance of supporting infrastructure that allows all students to access and benefit from interactive ODL tools. Investment in digital resources and training can help bridge the digital divide, ensuring that technological advancements benefit a broader range of learners. The research advocates for educational strategies that recognize the need for interactivity in online learning environments, promoting policies that make interactive technologies a standard component of ODL. By prioritizing accessible, interactive learning, institutions and policymakers can create more resilient, adaptable educational models for future generations.

The positive impact of interactive technologies on student engagement and satisfaction can be attributed to the alignment of these tools with students' social and cognitive needs. Interactive elements such as virtual classrooms and discussion forums offer opportunities for real-time feedback, collaboration, and active participation, which are essential to learning and retention. These features allow students to engage deeply with the material, promoting a sense of belonging in an otherwise isolated online environment. The tools also support diverse learning styles, catering to

students' unique needs and helping them engage with the content in meaningful ways.

Student satisfaction with interactive tools likely stems from their ability to mimic the dynamics of traditional classrooms, offering an experience that feels more personal and responsive. Gamified quizzes, for instance, add an element of enjoyment and reduce the stress of assessments, allowing students to test their knowledge in a low-pressure setting. The flexibility and interactivity of these tools empower students to take ownership of their learning, which is often lacking in conventional ODL environments. This shift towards learner-centered approaches enhances the overall educational experience, creating a more adaptive and supportive learning environment.

Future research should focus on assessing the long-term impacts of interactive technologies on learning outcomes, including retention, career readiness, and overall student success. Longitudinal studies would provide valuable insights into how interactive tools influence learning beyond course completion, shedding light on their role in lifelong learning. Additionally, expanding research to examine the effectiveness of these tools across different disciplines and educational levels could help tailor interactive solutions to specific learning needs. These efforts will be essential for understanding the broader implications of interactive technologies in education.

Efforts to address accessibility challenges are also critical in making interactive ODL tools universally effective. Developing cost-effective, resource-friendly tools that work across various devices and connectivity levels could extend the benefits of interactivity to a wider range of students. Research into effective training programs for educators on the integration of interactive tools would further support the successful adoption of these technologies. By exploring these directions, institutions and educators can work towards a more inclusive, effective, and interactive ODL experience for all students, ensuring that technological advancements in education are accessible and beneficial to all.

IV. CONCLUSIONS

The most important finding of this research is that interactive technologies significantly enhance engagement, satisfaction, and comprehension among students in Open Distance Learning (ODL) environments. Virtual classrooms, discussion forums, and gamified quizzes were identified as especially effective in creating a dynamic and supportive online learning experience. This study demonstrates that interactive tools are essential in addressing the challenges associated with traditional online education, such as student isolation and lack of motivation. These technologies not only promote active participation but also contribute to a deeper understanding of course content, making ODL more effective and engaging.

This research contributes to the field by providing a framework for understanding the specific benefits of various interactive technologies in ODL. By highlighting how tools like virtual classrooms and discussion boards replicate in-person interactions, this study supports the development of ODL models that mirror traditional classroom dynamics. The findings emphasize the value of a learner-centered approach, where interactive tools allow students to connect with peers and instructors, fostering a sense of community. This study offers both conceptual insights and practical guidance on how to integrate interactive technologies effectively, making it a valuable resource for educators and institutions.

One limitation of this study is its focus on short-term engagement and satisfaction, leaving the long-term impacts of interactive tools on learning outcomes unexplored. The absence of longitudinal data limits understanding of whether these technologies support sustained academic success and skill retention. Additionally, the study's sample was drawn from a limited number

of institutions, which may affect the generalizability of the findings across different cultural and socioeconomic contexts. Expanding future research to include diverse populations and long-term data would provide a more comprehensive understanding of the full impact of interactive technologies in ODL.

V. References

Al-Rawi, O. Y. M., Elfezzani, W., Edwar, M. E., Al-Rawi, B. O., & Rashed, A. N. (2025). Challenges and Recent Developments in Smart Education Post-COVID-19 Pandemic. In *Stud. Syst. Decis. Control* (Vol. 568, pp. 857–870). Springer Science and Business Media Deutschland GmbH; Scopus. https://doi.org/10.1007/978-3-031-71526-6_77

Azevedo, B. F., Pacheco, M. F., Fernandes, F. P., & Pereira, A. I. (2024). Dataset of mathematics learning and assessment of higher education students using the MathE platform. *Data in Brief*, *53*. Scopus. https://doi.org/10.1016/j.dib.2024.110236

Bankar, M. N., Bankar, N. J., Gajbe, U., Singh, B., Mishra, V. H., Bahadure, S., Bandre, G. R., Bankar, S. N., & Shelke, Y. P. (2024). A narrative literature review on new technologies for teaching anatomy. *International Journal of Academic Medicine*, *10*(2), 47–55. Scopus. https://doi.org/10.4103/ijam.ijam_30_24

Bondarenko, T., Kovalenko, D., Khotchenko, I., Zelenin, H., & Bozhko, V. (2024). Gamification of Educational Content by Using Virtual Teacher in Online Learning Environment. In Auer M.E., Cukierman U.R., Vendrell Vidal E., & Tovar Caro E. (Eds.), *Lect. Notes Networks Syst.: Vol. 901 LNNS* (pp. 447–454). Springer Science and Business Media Deutschland GmbH; Scopus. https://doi.org/10.1007/978-3-031-53022-7_44

Demazière, C., Stöhr, C., Zhang, Y., Cabellos, O., Dulla, S., Garcia-Herranz, N., Miró, R., Macian, R., Szieberth, M., Lange, C., Hursin, M., & Strola, S. (2024). Enhancing higher education through hybrid and flipped learning: Experiences from the GRE@T-PIONEeR project. *Nuclear Engineering and Design*, *421*. Scopus. https://doi.org/10.1016/j.nucengdes.2024.113028

Dodson, T. M., & Thompson-Hairston, K. (2025). A scoping review of gen z nursing students: Learning preferences and educator strategies. *Teaching and Learning in Nursing*, *20*(1), 85–90. Scopus. https://doi.org/10.1016/j.teln.2024.11.007

Elmi, C. (2024). Fostering students' inquiry aptitudes and collaborative reasoning in higher education science courses with social annotation tools and collaborative platforms. *School Science and Mathematics*. Scopus. https://doi.org/10.1111/ssm.18316

Falk, A. F., Jordaan, M., Saeed, S. T., Bhaskara Rao, M., & El Houda Chaoui, N. (2024). A program evaluation of an international, intercultural e-community-engagement initiative. *Journal of Applied Research in Higher Education*, *16*(4), 1160–1175. Scopus. https://doi.org/10.1108/JARHE-03-2023-0111

He, H. (2025). A Method for Sharing English Education Resources in Multiple Virtual Networks Based on 6G. *Int J Network Manage*, *35*(1). Scopus. https://doi.org/10.1002/nem.2319

Hosseini, S. A., Dabiri, A., Kashefian-Naeeini, S., & Mustapha, R. (2024). A comparison of the level of the ESP language learners' performance and engagement in a synchronous online course and the face-to-face course. *Forum for Linguistic Studies*, *6*(1). Scopus. https://doi.org/10.59400/fls.v6i1.1935

Hsia, J.-W. (2024). Factors Influencing Elementary Teachers' Satisfaction With Online Teaching in the Postpandemic Era in Central Taiwan. *Journal of Research in Education Sciences*, *69*(1), 69–97. Scopus. https://doi.org/10.6209/JORIES.202403_69(1).0003

Hu, Y.-H., Liao, B.-K., & Hsieh, C.-L. (2024). Effectiveness of a gamified learning analytics dashboard with coregulation mechanism for self-regulated learning in college ethics courses. *Interactive Learning Environments*, *32*(10), 6628–6644. Scopus. https://doi.org/10.1080/10494820.2023.2277741

Kaul, N., & Kumar, C. (2024). Exploring the Landscape of Virtual Reality in Education: A Bibliometric and Thematic Analysis. In *Transforming Education with Virtual Real.* (pp. 181–200). wiley; Scopus. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85193591019&partnerID=40&md5=a5c0f751f66c185ca2cd62890bd225ab

Korosidou, E., & Griva, E. (2024). Fostering Students' L2 Writing Skills and Intercultural Awareness Through Digital Storytelling In Elementary Education. *International Electronic Journal of Elementary Education*, *16*(5), 585–597. Scopus. https://doi.org/10.26822/iejee.2024.355

Liu, R., Xue, N., & Liang, J. (2024). ENHANCING ATHLETIC EDUCATION: INTEGRATING COMPUTER-ASSISTED TEACHING METHODS IN IDEOLOGICAL, POLITICAL, AND SOCIALIST HISTORY EDUCATION FOR SPORTS PROFESSIONALS. *Revista Internacional de Medicina y Ciencias de La Actividad Fisica y Del Deporte*, *24*(95). Scopus. https://doi.org/10.15366/rimcafd2024.95.039

Mujallid, A. (2024). Digital Active Learning Strategies in Blended Environments to Develop Students' Social and Emotional Learning Skills and Engagement in Higher Education. *European Journal of Education*, *59*(4). Scopus. https://doi.org/10.1111/ejed.12748

Nurhasanah, F., Nugraheni, A. S. C., Kusharjanta, B., Ardiansyah, R., Widono, S., & Saddhono, K. (2024). A Design of Virtual Classrooms Through AI, ML and DL to Improve the Level of Learning. *Int. Conf. Adv. Comput. Innov. Technol. Eng. ICACITE*, 940–945. Scopus.

https://doi.org/10.1109/ICACITE60783.2024.10616641

Papadopoulou, A., Mystakidis, S., & Tsinakos, A. (2024). Immersive Storytelling in Social Virtual Reality for Human-Centered Learning about Sensitive Historical Events. *Information (Switzerland)*, *15*(5). Scopus. https://doi.org/10.3390/info15050244

Prathibha, K. N., Upadhyaya, G., Jagadeesha, B., & Tantry, R. (2024). A Novel Evaluation on the Impact of Modern Pedagogical Tools for Improving the Learning Outcomes of Engineering Mathematics. *Proc. - Int. Conf. Adv. Comput., Commun. Appl. Informatics, ACCAI*. Proceedings - 3rd International Conference on Advances in Computing, Communication and Applied Informatics, ACCAI 2024. Scopus. https://doi.org/10.1109/ACCAI61061.2024.10601972

Ramasamy, V., Singsen, D., & Walia, G. S. (2024). Fostering Student Engagement and Success in STEM Education: An AI-Driven Exploration of High Impact Practices from Cross-Disciplinary General Education Courses. *Journal of Engineering Education Transformations*, *37*(Special Issue 2), 849–857. Scopus. https://doi.org/10.16920/jeet/2024/v37is2/24131

Ranti, C. D., Arumsari, G. M., & Lee, H. (2024). Exploring student and teacher perspectives on education with technological advancement in Indonesia through Design Thinking in response to COVID-19. *CERN IdeaSquare Journal of Experimental Innovation*, *8*(1), 36–42. Scopus. https://doi.org/10.23726/cij.2024.1475

Relucenti, M., Barbaranelli, C., Cristiano, L., Familiari, P., Miglietta, S., Donfrancesco, O., & Familiari, G. (2024). A comparative quali-quantitative analysis of student perspectives on microscopic anatomy labs: Traditional glass slide versus virtual slides approach. *Italian Journal of Anatomy and Embryology*, *128*(1), 125–135. Scopus. https://doi.org/10.36253/ijae-15379

Sadanala, G., Xu, X., He, H., Beuno-Vesga, J., & Li, S. (2024). Enhancing distance learning with virtual reality: Investigating learners' engagement and outcomes. *Distance Education*. Scopus. https://doi.org/10.1080/01587919.2024.2351929

Shadiev, R., Chen, X., Reynolds, B. L., Song, Y., & Altinay, F. (2024). Facilitating cognitive development and addressing stereotypes with a cross-cultural learning activity supported by interactive 360-degree video technology. *British Journal of Educational Technology*, *55*(6), 2668–2696. Scopus. https://doi.org/10.1111/bjet.13461

Singh, A. (2024). Impact of E-learning on Students' Motivation in Higher Education Institutions: An Indian Perspective. *Revista de Educacion y Derecho*, *29*. Scopus. https://doi.org/10.1344/REYD2024.29.43214

Soto, D., Higashida, M., Shirai, S., Ueda, M., & Uranishi, Y. (2024). Enhancing Learning Dynamics: Integrating Interactive Learning Environments and ChatGPT for Computer Networking Lessons. In Flearmoy J. (Ed.), *Procedia Comput. Sci.* (Vol. 246, Issue C, pp. 3595–3604). Elsevier B.V.; Scopus. https://doi.org/10.1016/j.procs.2024.09.198

Suraj, S., Kohle, S., Prakash, A., Tendolkar, V., & Gawande, U. (2024). Achievement Motivation Among Health Sciences and Engineering Students During COVID-19. *Annals of Neurosciences*, *31*(1), 36–43. Scopus. https://doi.org/10.1177/09727531231169628

Thongkoo, K., Daungcharone, K., & Panjaburee, P. (2024). Effects of Collaborative Inquiry-Based Online Approach in Thai University Students' Computing Program. *International Journal of Information and Education Technology*, *14*(2), 302–309. Scopus. https://doi.org/10.18178/ijiet.2024.14.2.2052

Villegas-Ch, W., García-Ortiz, J., & Sánchez-Viteri, S. (2024). Educational Advances in the Metaverse: Boosting Learning Through Virtual and Augmented Reality and Artificial Intelligence. *IEEE Access*, *12*, 59093–59112. Scopus. https://doi.org/10.1109/ACCESS.2024.3393776

Wang, M. (2025). Hybrid data clustering algorithm and interactive experience in E-learning electronic course simulation of legal education. *Entertainment Computing*, *52*. Scopus. https://doi.org/10.1016/j.entcom.2024.100760

Yadav, S., Siddiqui, M. N., Vats, Y., & Shukla, J. (2024). EngageME: Exploring Neuropsychological Tests for Assessing Attention in Online Learning. In Olney A.M., Chounta I.-A., Liu Z., Santos O.C., & Bittencourt I.I. (Eds.), *Lect. Notes Comput. Sci.: Vol. 14829 LNAI* (pp. 394–408). Springer Science and Business Media Deutschland GmbH; Scopus. https://doi.org/10.1007/978-3-031-64302-6_28

Zhang, Y., & Li, D. (2024). Human-machine interaction with intelligent machine learning algorithms for smart classrooms. *Australian Journal of Electrical and Electronics Engineering*. Scopus. https://doi.org/10.1080/1448837X.2024.2420519

Zhang, Y., Poulsen, C., Liu, C., & Salling, L. J. H. (2024). Designing of an AM Learning Factory Using Interactive Videos as a Didactic Approach. In Thiede S. & Lutters E. (Eds.), *Lect. Notes Networks Syst.: Vol. 1060 LNNS* (pp. 21–27). Springer Science and Business Media Deutschland GmbH; Scopus. https://doi.org/10.1007/978-3-031-65400-8_3