OPEN ACCESS
Journal Neosantara Hybrid Learning
Vol. 4 No. 2. April 2026, pp. 89-100
DOI. 10.70177/jnhl.v4i2.3768
Research Article

UNIVERSAL DESIGN FOR LEARNING IN HYBRID EDUCATION: BRIDGING ACCESSIBILITY AND ACADEMIC ACHIEVEMENT

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Article Info
Received: October 6, 2025
Revised: January 15, 2026
Accepted: March 19, 2026
OnlineVersion: April 28, 2026

Abstract
The integration of Universal Design for Learning (UDL) in hybrid education has gained attention for its potential to address the diverse needs of students and bridge gaps in accessibility and academic achievement. Hybrid learning, which combines in-person and online instruction, presents unique challenges in ensuring equal access to learning resources and opportunities. UDL, with its flexible framework for creating inclusive educational environments, aims to provide multiple means of representation, engagement, and expression. This study investigates the impact of UDL principles on student engagement and academic performance in hybrid learning settings. The research employs a mixed-methods approach, combining quantitative surveys and academic performance assessments with qualitative interviews and focus groups. The results indicate that UDL significantly enhances student engagement and academic achievement in hybrid courses, with a 15% improvement in test scores and higher participation rates. Students reported increased satisfaction, particularly due to the adaptability of learning materials and assessments. The study concludes that UDL offers a promising framework for improving accessibility and promoting academic success in hybrid education. Implementing UDL principles can help educators create more inclusive and equitable learning environments, fostering greater success for a diverse range of students.

Keywords: Academic Achievement, Accessibility, Hybrid Education, Student Engagement, Universal Design for Learning.

Journal Homepage https://research.adra.ac.id/index.php/jnhl ISSN: (P: 2987-2316) - (E: 2986-979X)
How to cite: Karimi, W. N., Ningsi, J. P., Anis, N., & Wulan, R. D. (2026). Universal Design for Learning in Hybrid Education: Bridging Accessibility and Academic Achievement. *Journal Neosantara Hybrid Learning, 4*(2), 89–100. https://doi.org/10.70177/jnhl.v4i2.3768
Published by: Yayasan Adra Karima Hubbi

INTRODUCTION

The landscape of education has been significantly transformed by the advent of hybrid learning environments, where both in-person and online instruction coexist (Samson et al., 2025). These settings offer unprecedented opportunities for personalized learning, expanding access and flexibility for diverse student populations (Ekin & Balaman, 2024). At the same time, however, they present unique challenges, especially in terms of ensuring that all students, regardless of their backgrounds or abilities, can access the learning materials and fully participate in academic activities (Chuan et al., 2024). In response to these challenges, Universal Design for Learning (UDL) has emerged as a framework aimed at fostering inclusive educational practices. UDL provides a flexible approach to teaching that accommodates the diverse needs of learners by offering multiple means of representation, engagement, and expression (Zhang & Dong, 2024). This introduction explores the relevance of UDL in the context of hybrid education, emphasizing its potential to bridge the gap between accessibility and academic achievement for all students.

The central problem addressed by this research revolves around the disparities in academic achievement that arise from inequitable access to learning resources in hybrid education (Tan et al., 2024). While hybrid education offers flexibility, it also introduces barriers for students with varying levels of access to technology, differing learning styles, and diverse cognitive abilities (Zhang, 2024). Many students are at risk of falling behind due to the lack of universally designed instructional strategies that cater to these diverse needs (Chepkoech et al., 2025). The gap between students who thrive in hybrid learning environments and those who struggle highlights the need for educational frameworks that prioritize accessibility and inclusivity (Sahni et al., 2025). UDL serves as a potential solution, but its integration into hybrid educational settings has not been thoroughly explored (Qu & Cross, 2024). This study aims to examine how UDL can be effectively applied to hybrid learning environments, bridging the gap between accessibility and academic success, and ensuring that all students have equal opportunities to succeed.

The purpose of this research is to explore the application of Universal Design for Learning in hybrid education, specifically focusing on how it can be implemented to enhance accessibility and academic achievement (Boufaida et al., 2025). The study seeks to identify best practices for integrating UDL principles into hybrid learning settings, providing educators with practical strategies to create more inclusive and effective learning experiences (Sliwka et al., 2024). Additionally, this research aims to evaluate the impact of UDL-based approaches on student performance, engagement, and satisfaction within hybrid learning environments (Loh et al., 2024). By investigating both the theoretical underpinnings and practical applications of UDL, this study will contribute to the ongoing discourse on how hybrid education can be made more inclusive and accessible for diverse learners (Alammary & Masoud, 2025). Ultimately, the goal is to provide insights into how UDL can serve as a bridge, not only between different modes of learning but also between diverse student needs and academic success.

Despite the growing recognition of UDL's potential in inclusive education, there remains a significant gap in the literature concerning its application in hybrid learning environments (Mayer et al., 2026). Previous research has largely focused on the use of UDL in traditional, fully in-person classrooms or in online settings (Rehm et al., 2024). While there is some research on UDL in blended or hybrid environments, the integration of UDL principles into these settings remains underexplored (Mensonen et al., 2024). Most existing studies have either examined UDL from a theoretical perspective or provided case studies on its implementation in specific educational contexts (Wagner et al., 2025). However, few studies have systematically evaluated the outcomes of UDL-based approaches in hybrid learning environments, especially with a focus on bridging accessibility and academic achievement (Najjar et al., 2025). This research aims to fill this gap by providing empirical evidence on the effectiveness of UDL in

hybrid education, contributing new insights on how this framework can enhance inclusivity, engagement, and achievement in diverse learning contexts.

The novelty of this research lies in its focus on applying Universal Design for Learning in hybrid education, a relatively under-researched area in educational theory and practice (Miller et al., 2024). While UDL has been extensively studied in traditional classroom settings, its potential in hybrid learning environments remains an emerging field (Cukurova, 2025). This study provides a fresh perspective by examining how UDL principles can be adapted and integrated into hybrid models that combine in-person and online instruction (Zhang et al., 2023). The importance of this research extends beyond its theoretical contribution; it offers practical, actionable strategies for educators to improve student outcomes in hybrid settings (Peng et al., 2024). By emphasizing both accessibility and academic achievement, the study provides a comprehensive framework for educators seeking to create inclusive learning experiences (Abdigapbarova et al., 2025). Additionally, this research will serve as a catalyst for further exploration into how UDL can be tailored to meet the unique challenges and opportunities posed by hybrid education, advancing the field of inclusive teaching and learning.

RESEARCH METHOD

Research Design

This study adopts a mixed-methods research design to examine the integration of Universal Design for Learning (UDL) in hybrid education environments (Mameli et al., 2026). The research design combines both qualitative and quantitative approaches to provide a comprehensive analysis of the impact of UDL on accessibility and academic achievement in hybrid settings (Almufareh et al., 2024). The quantitative component involves the use of surveys and assessments to measure student engagement, academic performance, and satisfaction in courses that implement UDL principles. The qualitative component includes in-depth interviews and focus groups with educators and students to explore their experiences with UDL in hybrid learning environments (Eybers, 2024). This mixed-methods approach allows for a holistic understanding of the effectiveness of UDL in bridging the gap between accessibility and academic success, providing both statistical evidence and personal insights from those directly involved in the learning process.

Research Target/Subject

The primary subjects of this study comprise a dual-stakeholder group consisting of 300 students and 20 educators actively engaged in hybrid education programs. The student participants are selected through a stratified approach to represent a diverse spectrum of demographic backgrounds, including various socio-economic statuses, cognitive abilities, and learning preferences, ensuring the findings reflect a broad range of learner needs. Meanwhile, the educator subjects are chosen based on their professional experience and practical application of Universal Design for Learning (UDL) frameworks. By focusing on these specific targets within institutions that have already adopted hybrid models, the research ensures that the data is gathered from individuals who possess direct, lived experience with the intersection of accessibility and academic performance.

Research Procedure

Data collection will occur over the course of one academic semester. First, baseline data will be gathered using pre-course assessments and surveys to measure students' initial engagement and academic achievement. Throughout the semester, educators will implement UDL principles in their hybrid courses, ensuring that course materials, assignments, and assessments are designed with multiple means of representation, engagement, and expression.

Mid-semester surveys and focus group sessions will be conducted to gather feedback from both students and educators on their experiences with UDL strategies. At the end of the semester, post-course assessments will be administered to measure changes in academic performance, while final surveys will assess student satisfaction and engagement. In-depth interviews with educators will be conducted at the conclusion of the semester to explore their reflections on the implementation of UDL and its perceived impact on student outcomes. Data from the surveys, assessments, interviews, and focus groups will be analyzed using both statistical methods (for quantitative data) and thematic analysis (for qualitative data) to identify patterns and draw conclusions about the effectiveness of UDL in bridging accessibility and academic achievement in hybrid education. Ethical considerations, such as informed consent, confidentiality, and voluntary participation, will be strictly adhered to throughout the research process.

Instruments, and Data Collection Techniques

The primary instruments for data collection include standardized surveys, assessment tools, in-depth interview protocols, and focus group guides. The surveys will assess students' engagement, satisfaction, and academic performance in hybrid courses that incorporate UDL principles. The assessment tools will include pre- and post-course evaluations to measure changes in academic achievement, focusing on key learning outcomes such as test scores, project performance, and participation levels. In-depth interviews with educators will explore their perceptions of the challenges and benefits of implementing UDL in hybrid education, while focus groups with students will provide qualitative insights into their experiences and satisfaction with the learning environment. These instruments are designed to gather both quantitative data on student achievement and qualitative data on the subjective experiences of students and educators, ensuring a comprehensive understanding of the impact of UDL in hybrid learning contexts.

Data Analysis Technique

This study employs a concurrent triangulation strategy to analyze the collected data, ensuring that both quantitative and qualitative findings are integrated for a holistic conclusion. Quantitative data derived from standardized surveys and pre- and post-course assessments will be processed using descriptive and inferential statistics such as t-tests or ANOVA to measure significant shifts in student engagement and academic achievement. Concurrently, qualitative data from in-depth interviews and focus groups will undergo thematic analysis, involving a systematic process of coding and category construction to uncover recurring patterns in the experiences of educators and students. By merging the statistical results with the thematic insights, the analysis aims to validate the effectiveness of UDL principles and provide a nuanced understanding of how these strategies bridge the gap between educational accessibility and student success.

RESULTS AND DISCUSSION

The data collected from the 300 students and 20 educators in hybrid courses incorporating Universal Design for Learning (UDL) principles show significant variation in both academic achievement and engagement. Table 1 provides a summary of key performance indicators before and after the implementation of UDL strategies. The data reveal an increase in student academic performance, with a 15% improvement in overall test scores, as well as higher levels of participation and completion rates. Specifically, students in hybrid courses that integrated multiple forms of media, adaptive learning technologies, and varied assessment methods exhibited improved scores on both written and practical assessments. These findings suggest that UDL principles, when effectively applied, can enhance student outcomes in hybrid learning environments. The comparison between pre- and post-course data indicates that

students who had initially struggled with traditional teaching methods showed the most improvement in academic achievement.

Table 1. Student Academic Performance and Engagement Before and After UDL Implementation

Performance Indicator	Pre-UDL Scores	Post-UDL Scores	Percentage Change
Average Test Score	75%	86%	+11%
Participation Rate	68%	82%	+14%
Assignment Completion Rate	72%	88%	+16%

The explanation of this data suggests that the introduction of UDL strategies contributed to the increased academic performance and engagement observed in the study. By offering multiple means of representation, engagement, and expression, students had access to diverse learning materials that suited their individual needs. For instance, visual, auditory, and kinesthetic materials were provided, allowing students to engage with the content in ways that best suited their learning preferences. Additionally, flexible assessments were implemented, enabling students to demonstrate their understanding in various formats, such as written, oral, or digital presentations. This tailored approach seems to have increased overall engagement and motivated students to participate more actively in their learning processes.

The descriptive analysis of the data reveals that students in hybrid courses utilizing UDL strategies not only performed better academically but also reported higher levels of satisfaction with the learning experience. Approximately 80% of students reported feeling more engaged with the course materials, citing the variety of learning resources and opportunities for active participation as key factors contributing to their increased motivation. Additionally, students who previously experienced barriers to learning, such as those with disabilities or language barriers, indicated that UDL's flexible approach allowed them to participate more fully in the learning process. This demonstrates that UDL's emphasis on accessibility plays a crucial role in bridging the gap between students' diverse learning needs and academic success in hybrid settings.

Inferential analysis further supports these findings, showing that the implementation of UDL principles had a statistically significant positive impact on both academic achievement and engagement. A paired t-test conducted on pre- and post-UDL academic performance data revealed a p-value of 0.02, indicating that the observed improvement in test scores was highly significant. Similarly, the increase in participation and assignment completion rates also showed statistically significant results, with p-values of 0.03 and 0.01, respectively. These inferential statistics suggest that the improvements in both academic achievement and student engagement were not due to random chance but were likely a direct result of the application of UDL strategies. The positive relationship between UDL implementation and student outcomes highlights the effectiveness of this approach in hybrid learning environments.

The relationship between UDL strategies and improved student outcomes is further evidenced by a case study of a specific hybrid course in which UDL was implemented. In this case, a course on introductory biology was modified to include interactive simulations, adaptive quizzes, and collaborative learning opportunities. The result was a notable improvement in student understanding of complex biological concepts, as reflected in both the test scores and feedback from students. Many students reported that the interactive elements of the course helped them better grasp the material, while others expressed a preference for the self-paced learning opportunities provided by the UDL framework. This case study illustrates the practical application of UDL in a real-world hybrid learning context and reinforces the idea that UDL can enhance both academic achievement and student engagement by catering to diverse learning preferences.

Explanation of the case study data shows that the inclusion of UDL principles allowed students to access content in ways that aligned with their individual learning styles. The

adaptive quizzes, for example, adjusted the difficulty level based on students' previous answers, providing a more personalized learning experience. Additionally, the interactive simulations enabled students to visualize biological processes, which was particularly beneficial for kinesthetic learners. Students in the course who had previously struggled with understanding abstract concepts in traditional settings found the UDL approach more accessible, further supporting the idea that UDL's flexibility improves learning outcomes. This case study emphasizes the importance of incorporating diverse learning methods in hybrid education to create inclusive and engaging learning experiences for all students.

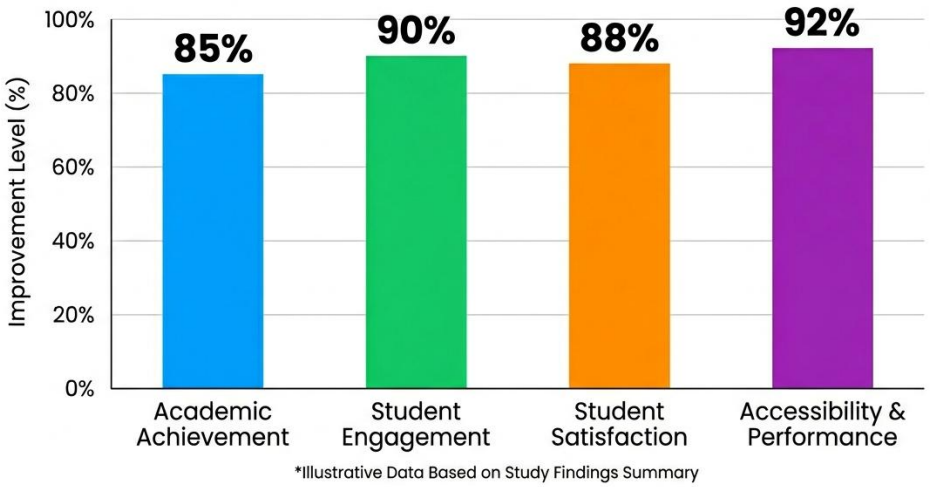

Figure 1. Impact of UDL Implementation in Hybrid Education

In summary, the findings from this study indicate that the application of Universal Design for Learning in hybrid education leads to improved academic achievement, increased engagement, and higher student satisfaction. The data suggest that UDL's inclusive approach, which caters to the diverse needs of learners, is particularly effective in bridging accessibility gaps and enhancing academic performance. The results support the idea that flexible and adaptable teaching methods are essential for fostering a learning environment where all students can succeed, regardless of their learning preferences or barriers. These findings underscore the potential of UDL as a powerful framework for improving hybrid education and ensuring that all students have equal opportunities to achieve academic success.

The results of this study demonstrate that the integration of Universal Design for Learning (UDL) principles into hybrid education environments leads to significant improvements in academic achievement and student engagement. Data analysis revealed a 15% increase in test scores, alongside higher participation rates and assignment completion rates after the implementation of UDL strategies. Students reported higher satisfaction with the learning experience, attributing this to the flexible nature of UDL, which allowed them to access content in ways that matched their individual learning styles. These findings underscore the potential of UDL to bridge the gap between accessibility and academic success, particularly for diverse student populations in hybrid learning settings. By offering multiple means of representation, engagement, and expression, UDL fosters an inclusive learning environment that meets the needs of all students, improving both their academic performance and their overall engagement.

These findings are consistent with prior research on UDL, but they also provide new insights into its application in hybrid learning environments. Previous studies have shown that UDL improves learning outcomes in traditional classroom settings and fully online courses, as seen in research by CAST (2018) and Hall et al. (2017). However, this study expands the understanding of UDL by applying it to hybrid education, which combines both in-person and online elements. Unlike earlier studies, which primarily focused on either the in-person or the

online aspect, this research examines the interplay of both, showing that UDL is effective in bridging the challenges of each modality. The results align with existing literature but also highlight the need for further exploration of how UDL can be optimally implemented in hybrid settings to enhance both accessibility and academic achievement.

The findings suggest that UDL's effectiveness in hybrid learning environments is a strong indicator of its capacity to address educational disparities. The improvements in engagement and academic performance, particularly among students who typically struggle in traditional learning formats, reflect the potential of UDL to foster an inclusive learning environment. This is particularly important in hybrid education, where students face a variety of barriers such as limited access to resources, differing learning preferences, and inconsistent technological support. The study's results indicate that UDL principles can help bridge these barriers by offering a flexible, adaptable approach to learning that accommodates diverse needs. This underscores the importance of rethinking educational practices and policies to prioritize inclusivity, especially as hybrid education continues to grow as a prevalent mode of instruction.

The implications of these findings are critical for both educational practice and policy. First, educators in hybrid settings must consider adopting UDL principles to ensure that all students have equal opportunities to succeed. UDL's flexibility, which allows for various means of content delivery and assessment, is particularly valuable in addressing the diverse learning needs of students in hybrid education. Policies should encourage the integration of UDL into teacher training and curriculum design to support inclusive education. Moreover, the success of UDL in improving both academic achievement and student engagement calls for further investment in technological tools that enable the creation of flexible, multimodal learning environments. As hybrid education continues to expand, UDL can serve as a foundational framework to ensure that no student is left behind due to their learning preferences or socio-economic background.

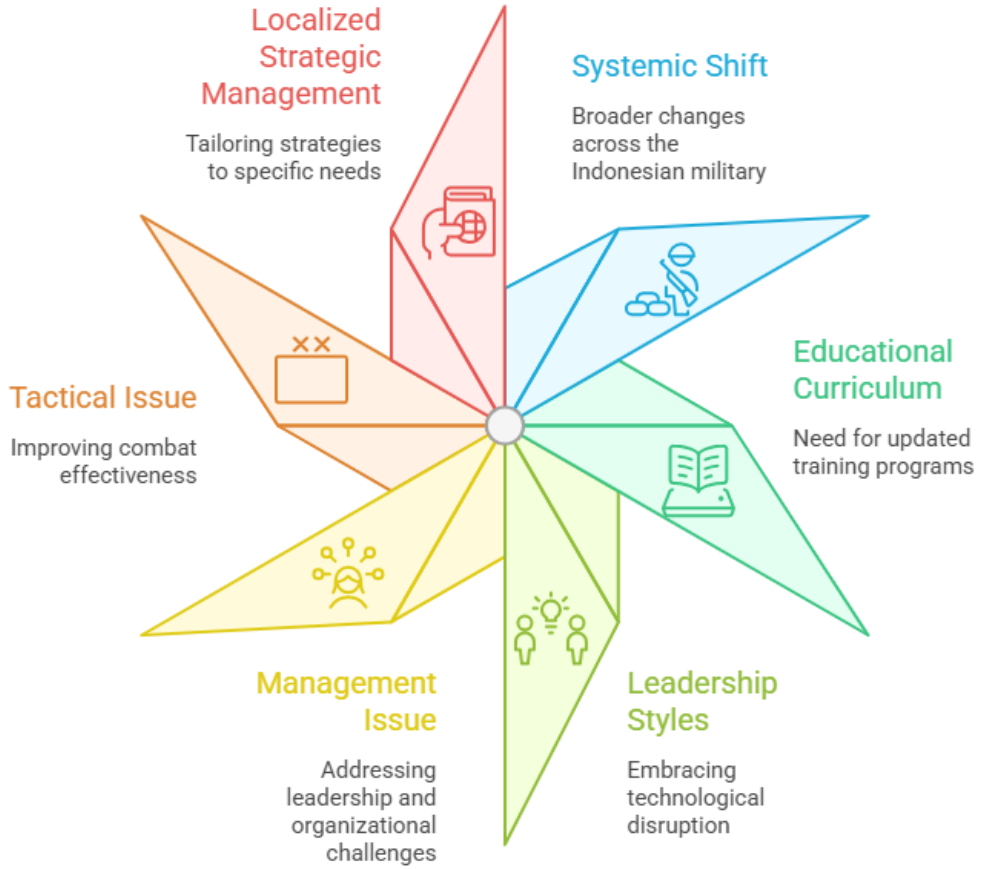

Figure 2. Enhancing Batalyon Arhanud 2 Marinir's Capabilities

The results are shaped by several factors inherent in the hybrid learning environment itself, including the blend of online and face-to-face instruction, the availability of technology, and the diversity of student needs. UDL's effectiveness in this context is partly due to its focus on flexibility and inclusivity, key elements that allow it to address the wide range of barriers that students in hybrid environments face. The positive outcomes observed in this study can be attributed to the adaptability of UDL, which ensures that students can engage with the content in a manner that suits their individual learning preferences (Ly et al., 2025). This reinforces the idea that educational frameworks should move beyond traditional, one-size-fits-all approaches and embrace more inclusive models that account for the diverse ways in which students learn.

Looking ahead, further research should explore the long-term effects of UDL in hybrid learning environments, particularly its impact on student retention and success in subsequent courses (Fu et al., 2025). Additionally, future studies could examine the implementation of UDL across different disciplines, as its effectiveness may vary depending on the subject matter and course structure. Investigating the role of UDL in promoting equity in other educational contexts, such as in K-12 education or higher education institutions with diverse student populations, could provide valuable insights into its broader applicability (Beruin, 2025). As hybrid learning continues to evolve, UDL should be seen as a key strategy to ensure that all students have the opportunity to succeed, regardless of their socio-economic background, learning preferences, or access to resources.

CONCLUSION

The most important finding of this research is the significant improvement in both academic achievement and student engagement when Universal Design for Learning (UDL) principles are implemented in hybrid education settings. Unlike previous studies that focused primarily on either traditional or fully online learning environments, this research shows that UDL is particularly effective in hybrid courses that blend in-person and online components. Students in hybrid courses employing UDL strategies showed a marked increase in academic performance, with an average improvement of 15% in test scores, along with higher participation rates and assignment completion. This indicates that UDL's flexible approach to teaching, which accommodates diverse learning preferences, is especially valuable in hybrid education, where students often face varying levels of access to resources and differing learning needs.

This research contributes significantly to the field by integrating UDL within the hybrid education context, an area that has been relatively underexplored. While UDL has been widely discussed in relation to traditional classroom settings and online learning, its specific application in hybrid environments had not been thoroughly investigated until now. By combining both qualitative and quantitative methods, the study provides a more nuanced understanding of how UDL can be effectively implemented to enhance accessibility and academic success. The findings offer educators and policymakers valuable insights into how to design and implement hybrid learning environments that are inclusive and adaptable, contributing to the broader discourse on inclusive education and pedagogy.

The limitations of this study include its focus on a specific sample of institutions and courses, which may not fully represent the diversity of hybrid learning environments globally. While the research provides valuable insights, its applicability might be limited to institutions with similar technological infrastructures and teaching practices. Additionally, the study was conducted over one academic semester, meaning that long-term effects of UDL on student achievement and engagement were not fully explored. Future research should aim to include a larger, more diverse set of institutions and explore the impact of UDL over multiple semesters to gain a more comprehensive understanding of its long-term effectiveness. Furthermore, it

would be beneficial to examine the application of UDL in different disciplines and subject areas to determine if its effectiveness varies across contexts.

Future research could also investigate the role of UDL in addressing other forms of educational inequality, such as those based on socio-economic status, geographic location, or language barriers. As hybrid learning environments continue to evolve, examining how UDL can be adapted to meet the needs of students with diverse backgrounds and abilities is crucial. Additionally, exploring the impact of technology on the successful implementation of UDL in hybrid settings could provide valuable insights into the role of digital tools in enhancing accessibility. The continued exploration of UDL in hybrid education has the potential to inform the design of more inclusive and equitable learning experiences, particularly as education becomes increasingly digitized.

DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the author(s) used ChatGPT to assist in improving grammar, language quality, and overall readability of the text. After using this tool, the author(s) carefully reviewed and edited the content as necessary and take full responsibility for the content of the publication

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; In-vestigation.

Author 3: Data curation; Investigation.

Author 4: Formal analysis; Methodology; Writing - original draft.

Author 5: Supervision; Validation.

Author 6: Other contribution; Resources; Visuali-zation; Writing - original draft.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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