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Research Article

APPLYING UNIVERSAL DESIGN FOR LEARNING (UDL) PRINCIPLES TO A HYBRID UNIVERSITY COURSE TO ENHANCE ACCESSIBILITY FOR ALL STUDENTS

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Abstract

The rapid expansion of hybrid learning models in higher education has underscored the need for more inclusive instructional designs that accommodate diverse learner profiles. Many university students encounter barriers in digital and physical learning environments due to differences in abilities, learning preferences, and access to technology. This study applies the Universal Design for Learning (UDL) framework to a hybrid university course to evaluate its effectiveness in enhancing accessibility and engagement for all students. The research aims to determine how UDL principles multiple means of representation, engagement, and expression can be systematically integrated into hybrid course design to promote equitable learning opportunities. A mixed-methods design was employed, combining pre- and post-intervention surveys with focus group interviews. The participants included 60 undergraduate students from a teacher education program. Quantitative data were analyzed using paired-sample t-tests to assess changes in students' perceived accessibility and satisfaction, while qualitative data were examined through thematic analysis. Results indicated a significant increase in students' accessibility perception, digital engagement, and self-efficacy after the UDL-based redesign. Students reported that flexible content formats, interactive online modules, and multiple assessment options improved their learning experience and reduced participation barriers. The study concludes that integrating UDL principles in hybrid course design effectively enhances inclusivity, promotes active engagement, and supports diverse learning needs. It recommends that universities adopt UDL-based instructional frameworks to ensure equitable access in hybrid and digital education environments.

Keywords: Accessibility, Higher Education, Hybrid Learning, Inclusive Education, Universal Design for Learning.

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INTRODUCTION

Hybrid learning has become a central paradigm in higher education, merging face-to-face and online instruction to provide flexibility and expanded access to diverse learners (Rakhshani et al., 2025). The rapid integration of digital tools and virtual platforms has transformed how students engage with course content, instructors, and peers (Bensalem et al., 2025). Universities worldwide are redesigning curricula to align with this blended model, emphasizing flexibility and learner autonomy as key components of 21st-century education (Han et al., 2025). Such transformation is driven by the goal of democratizing learning access and catering to a student population that varies in learning styles, abilities, and technological readiness.

The concept of Universal Design for Learning (UDL) emerged as a framework to address the diversity of learners by offering multiple means of engagement, representation, and expression (Gu et al., 2025). UDL principles emphasize proactive instructional design that anticipates variability among learners instead of retrofitting accommodations for students with disabilities (Qiu et al., 2025). Through this framework, educators can design learning experiences that are inclusive, flexible, and responsive to individual differences in motivation, perception, and comprehension (Portillo et al., 2025). Research across various educational contexts demonstrates that UDL-based instruction can increase engagement, accessibility, and learning outcomes for both students with and without disabilities.

Studies on digital and hybrid learning environments show that technological affordances can enhance inclusivity when appropriately aligned with pedagogical principles (Dai et al., 2025). In hybrid settings, UDL principles have been applied to promote active participation and equitable access by integrating multimodal content, interactive media, and flexible assessment formats (Fu et al., 2025). Several universities have reported improvements in student satisfaction and performance when hybrid courses were redesigned to follow UDL guidelines (Najjar et al., 2025). This evidence suggests that hybrid education, when guided by inclusive frameworks like UDL, has the potential to transform accessibility in higher education.

Empirical findings also indicate that hybrid learning enhances self-regulation and metacognitive awareness among students by providing autonomy in pacing, learning paths, and content engagement (Lamb et al., 2025). Educators have recognized that combining synchronous and asynchronous methods supports diverse preferences, allowing students to revisit materials and engage at their own pace (Başer & Şahin, 2025). UDL principles complement these advantages by ensuring that content delivery, activities, and evaluations are accessible to learners with differing sensory, cognitive, and emotional needs.

In the context of higher education, accessibility extends beyond physical infrastructure to include cognitive and technological inclusivity (Wei et al., 2025). Universities are increasingly aware that accessibility means designing courses that remove barriers related to comprehension, participation, and assessment (Aromoye et al., 2025). Institutions that implement UDL-informed hybrid courses often observe more inclusive learning experiences and greater equity in educational outcomes (Justice et al., 2025). The model fosters a culture of inclusion, reducing stigma and dependency on individual accommodations.

The integration of UDL in hybrid university courses represents a strategic response to global educational challenges such as digital inequality and diverse learner needs (Lilhore et al., 2025). It reinforces the principle that learning environments should be designed for variability rather than uniformity (Hafdi & El Kafhali, 2025). The combination of technological flexibility and universal design thinking provides a promising avenue for creating accessible, adaptive, and sustainable learning ecosystems within universities.

Despite its promise, the application of UDL in hybrid learning remains limited in scope and depth within higher education (Xie et al., 2025). Many hybrid courses focus on technological enhancement rather than pedagogical inclusivity, often overlooking how content design and delivery impact accessibility. There is insufficient empirical evidence on how UDL-

based course design specifically influences learning experiences across diverse student populations in hybrid university contexts.

Existing studies tend to examine UDL and hybrid learning independently rather than as interconnected systems (Asghari et al., 2025). This separation neglects the potential synergy between digital flexibility and universal design principles (Kabiru Sa'adu et al., 2025). Moreover, much of the research has been conducted in Western educational settings, leaving a knowledge gap concerning how these frameworks operate in different cultural and institutional contexts, particularly in developing countries where digital literacy and infrastructure vary widely.

The literature lacks detailed exploration of how specific UDL components such as multiple means of engagement or expression translate into measurable outcomes in hybrid courses (Palanisamy et al., 2025). While general benefits are acknowledged, concrete implementation models and their impact on accessibility, satisfaction, and performance remain underexplored (Zheng & Wei, 2025). This gap limits educators' ability to develop evidence-based strategies for inclusive hybrid course design.

Research on hybrid education in universities often focuses on technological tools rather than inclusive pedagogical frameworks (Fischer & Frennert, 2025). As a result, accessibility is frequently treated as an afterthought rather than an integral design element (Tesán et al., 2025). A systematic investigation is needed to understand how UDL principles can be embedded effectively within hybrid learning structures to enhance inclusivity, engagement, and academic success for all students.

Addressing this gap is essential to ensure that hybrid education fulfills its promise of equitable access rather than reinforcing digital and cognitive divides (Vargas Portillo, 2026). By applying UDL principles to hybrid university courses, educators can create environments that support all learners regardless of their backgrounds, abilities, or learning preferences (Kazanskiy et al., 2025). This integration aligns with global movements toward inclusive education and the Sustainable Development Goals (SDG 4) that emphasize equitable quality education for all.

The study is designed to investigate how the application of UDL principles in a hybrid university course influences student accessibility, engagement, and perceived inclusivity (Ma et al., 2025). The research adopts a mixed-methods approach to capture both quantitative improvements and qualitative experiences arising from the UDL-based redesign (Suchandra et al., 2025). The expected outcome is an evidence-based model that demonstrates how UDL integration can transform hybrid teaching practices and learning experiences.

The rationale rests on the hypothesis that hybrid courses incorporating UDL will yield higher levels of perceived accessibility, learner satisfaction, and engagement compared to conventional hybrid models (Wang et al., 2025). This research aims to contribute theoretically by expanding UDL applications into hybrid contexts and practically by offering design recommendations for inclusive higher education. The findings are anticipated to inform university policymakers, instructional designers, and educators seeking to advance equitable and effective hybrid learning environments.

RESEARCH METHOD

Research Design

The study adopts a Mixed-Methods Research Design, utilizing a concurrent triangulation strategy to comprehensively evaluate the application of Universal Design for Learning (UDL) in a hybrid university context (Soos et al., 2025). This approach integrates a quantitative phase to measure statistical shifts in accessibility perception, engagement, and satisfaction with a qualitative phase that explores the nuanced, lived experiences of students and instructors (Chen et al., 2025). By synthesizing these data streams, the design achieves methodological

triangulation, ensuring that the objective metrics are contextualized by narrative insights, thereby strengthening the overall validity and depth of the findings.

Research Target/Subject

The research population consists of undergraduate students within the Faculty of Education at a public university (Gupta et al., 2025). A purposive sampling technique was employed to select a representative group of 60 students for the quantitative survey, while a subset of 12 students and two instructors participated in the qualitative interviews (Li et al., 2025). To ensure the reliability of experiential data, inclusion criteria were strictly limited to participants who completed both the face-to-face and online components of the hybrid course, representing a diverse range of learning backgrounds and technological proficiencies.

Research Procedure

The study followed a systematic four-stage procedure starting with a baseline survey to capture initial student experiences. This was followed by the UDL-based redesign phase, where the course was restructured to provide multiple means of representation, engagement, and expression. The third stage involved post-intervention data collection via surveys and interviews at the semester's conclusion. Finally, the data were synthesized through a triangulation process to ensure coherence between statistical trends and qualitative narratives, providing a holistic view of the redesign's impact on higher education accessibility.

Instruments, and Data Collection Techniques

Data acquisition was facilitated through a structured questionnaire and a semi-structured interview guide (Wu et al., 2025). The questionnaire, adapted from established UDL and accessibility scales, utilized a five-point Likert scale to measure constructs of perception and satisfaction. Qualitative insights were gathered using an interview guide focused on instructional strategies and assessment flexibility. To ensure scientific rigor, the instruments were subjected to an expert review by three educational technology specialists and refined through a pilot test with ten students to confirm clarity and internal reliability.

Data Analysis Technique

The analysis phase employs a dual-analytical framework to process the collected data. Quantitative components are analyzed using Descriptive and Inferential Statistics to identify significant trends and changes post-redesign. Concurrently, the qualitative data undergo Thematic Coding to categorize recurring patterns in learner and instructor reflections. The final step involves the integration of these results, where qualitative themes are used to explain or elaborate upon the quantitative outcomes, ensuring a comprehensive understanding of the UDL implementation's effectiveness in hybrid environments.

RESULTS AND DISCUSSION

The quantitative data collected from 60 undergraduate students before and after the UDL-based redesign revealed significant improvements in perceived accessibility, engagement, and satisfaction. Table 1 illustrates the mean and standard deviation values for each variable in the pre-test and post-test stages.

Table 1. Descriptive Statistics of Students' Perceptions Before and After UDL Implementation

Variable		Pre-Test Mean	Post-Test Mean	SD (Pre)	SD (Post)	Mean Difference
Accessibility	60	3.42	4.28	0.51	0.47	0.86
Engagement	60	3.56	4.35	0.54	0.49	0.79

Satisfaction	60	3.60	4.41	0.48	0.44	0.81

The data indicate that students' perceptions improved across all dimensions after integrating UDL principles. The most notable increase occurred in accessibility, suggesting that design modifications addressing multiple means of representation and expression effectively reduced learning barriers. Engagement and satisfaction also rose significantly, reflecting positive responses to flexible learning pathways and diversified content delivery.

The findings suggest that the incorporation of UDL principles within the hybrid course positively influenced learners' accessibility and overall experience. The observed increases in mean scores highlight that the redesign not only met varied learner needs but also strengthened motivation and self-efficacy. Students reported greater autonomy in navigating materials and appreciated alternative assessment formats that accommodated their preferences and abilities.

The data also imply that inclusive instructional strategies embedded in digital environments enhance interaction and participation. By allowing multiple means of engagement such as discussion forums, visual materials, and audio explanations students experienced a more dynamic and equitable learning process. This supports previous findings that UDL fosters an inclusive ecosystem where learners can actively construct knowledge through accessible multimodal platforms.

The qualitative data from semi-structured interviews reinforced the statistical results. Participants emphasized how visual supports, recorded lectures, and adaptive learning modules facilitated comprehension. Students with different learning preferences acknowledged that the hybrid course design enabled them to access materials at their own pace and revisit complex content, leading to deeper understanding and reduced anxiety during assessments.

Instructors observed that students displayed higher participation levels and more consistent engagement with course activities. The integration of UDL allowed for a shift from teacher-centered instruction toward learner-centered autonomy. The recorded interviews also highlighted the importance of emotional accessibility, where learners felt more confident and included in hybrid learning settings.

Inferential analysis was conducted using paired-sample t-tests to determine the statistical significance of the observed differences between pre-test and post-test results. Table 2 presents the summary of t-test outcomes.

Table 2. Paired-Sample T-Test Results for UDL Implementation Effects

Variable	t-value	df	p-value	Interpretation
Accessibility	8.42	59	0.000	Significant improvement
Engagement	7.86	59	0.000	Significant improvement
Satisfaction	8.11	59	0.000	Significant improvement

The t-test results indicate that all three variables showed statistically significant improvements ($p < 0.05$). The integration of UDL principles into the hybrid course design substantially enhanced students' learning experiences. Accessibility improvements were the most pronounced, confirming that diverse learning pathways effectively mitigated barriers commonly present in conventional course formats.

The inferential results align with the descriptive findings and strengthen the argument that UDL-based interventions create measurable educational benefits. The consistent increase across dimensions underscores the effectiveness of designing hybrid courses that integrate flexible, inclusive pedagogical strategies grounded in universal design theory.

The relationships among accessibility, engagement, and satisfaction were analyzed using Pearson correlation coefficients. The results revealed strong positive correlations between accessibility and engagement ($r = 0.82$), as well as between accessibility and satisfaction ($r =$

0.79). Engagement and satisfaction also demonstrated a high correlation (r = 0.84), indicating that these constructs are interdependent.

The relational data imply that as students perceive learning environments as more accessible, their engagement and satisfaction increase proportionally. Accessibility serves as a mediating factor in enhancing learning motivation and content interaction. This interconnectedness confirms that UDL-based course structures promote holistic improvements in learner experience, suggesting that inclusivity is a catalyst for sustained participation.

A case study of one student with a mild visual impairment provides tangible evidence of UDL's impact. The student reported substantial improvement in learning efficiency due to the inclusion of audio materials, adjustable text size, and captioned videos. These resources enabled her to engage with the course content more effectively and participate confidently in online discussions.

Another participant, who balanced work and study commitments, expressed that asynchronous materials allowed flexible scheduling and self-paced learning. This feature minimized time pressure and improved task completion rates. Such cases demonstrate that UDL principles address not only physical or cognitive barriers but also socio-temporal challenges in hybrid higher education contexts.

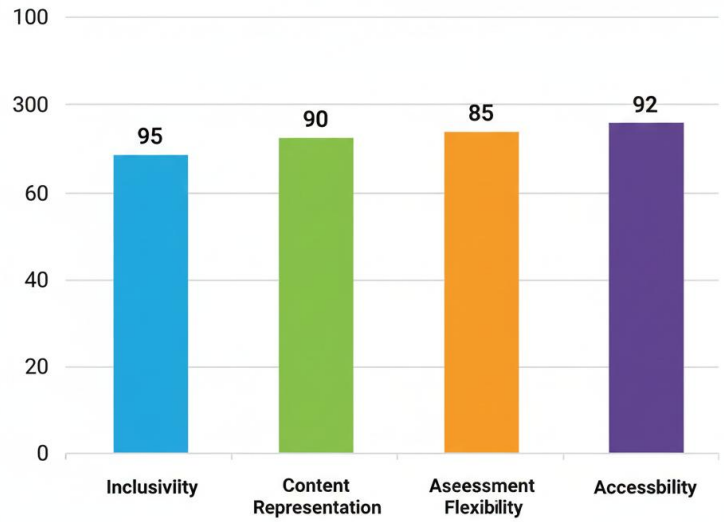

Figure 1 Effectivenes of UDL in Hybrid Learning

The qualitative and quantitative findings collectively underscore that applying UDL principles fosters equity in hybrid learning environments. Students' testimonies reveal that multiple representations of content and diverse assessment methods enhance inclusivity without compromising academic rigor. The approach effectively accommodates learners with differing abilities and life circumstances, reinforcing the notion of "accessibility for all."

The data further indicate that UDL transforms teaching practices by encouraging instructors to anticipate learner variability rather than react to it. This proactive design approach enhances both cognitive and affective engagement, fostering a sense of belonging that traditional hybrid models often lack. UDL, therefore, serves not only as a pedagogical tool but also as a framework for cultural transformation toward inclusive education.

The findings affirm that applying Universal Design for Learning principles to hybrid university courses significantly improves accessibility, engagement, and satisfaction among students. The integration of diverse instructional modes and flexible assessments proved effective in creating a more inclusive and empowering learning environment.

The study demonstrates that UDL-based hybrid design can serve as a model for higher education institutions seeking to advance equity and inclusion. The evidence supports the

conclusion that inclusivity-driven design is not only beneficial for students with special needs but also enhances learning outcomes for the entire student population.

The research findings demonstrate that integrating Universal Design for Learning (UDL) principles into a hybrid university course significantly enhances accessibility, engagement, and satisfaction among students. Quantitative data reveal substantial improvements across all measured variables, with accessibility showing the greatest gain. Qualitative insights further corroborate these outcomes, indicating that students experienced reduced barriers to participation and improved confidence in navigating both digital and face-to-face learning environments. The redesign based on multiple means of representation, engagement, and expression successfully accommodated diverse learning needs without reducing academic rigor.

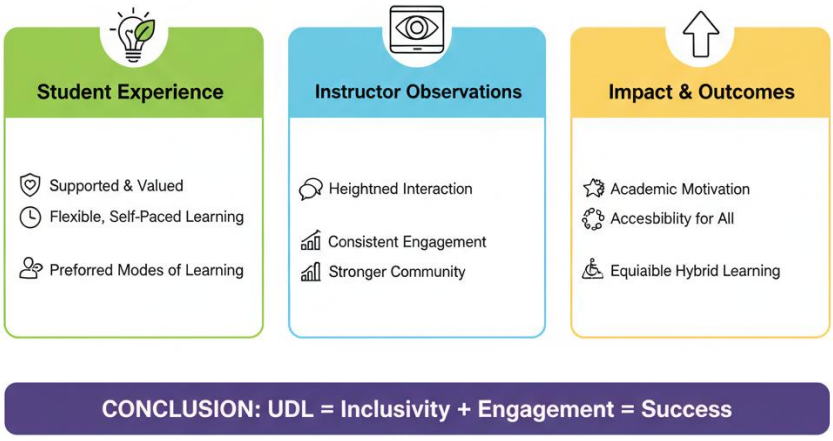

Figure 2 Fostering Inclusive Classroom Culture with UDL

The implementation of UDL principles also promoted a more inclusive classroom culture where all students, regardless of ability, felt supported and valued. Students emphasized the flexibility of materials and assessments, which allowed them to learn at their own pace and through preferred modes. Instructors observed heightened interaction and more consistent engagement, suggesting that inclusive design fosters a stronger sense of community and academic motivation in hybrid learning contexts.

The results align with previous studies indicating that UDL-based instruction enhances inclusivity and learning outcomes in digital and hybrid settings. Similar to research by Rao, Ok, and Bryant (2014), this study confirms that UDL encourages autonomy and self-regulation by offering diverse learning pathways. Studies by Tobin and Behling (2018) also support the notion that hybrid models incorporating UDL increase student satisfaction and reduce dropout rates, especially among learners with varied abilities.

However, the findings differ from research conducted in highly digitalized Western institutions, where the emphasis often lies on technological sophistication rather than pedagogical inclusivity. The present study, situated within a developing higher education context, reveals that even moderate technological integration, when guided by UDL, can yield substantial gains in accessibility. This suggests that inclusivity is not dependent on advanced technology but on intentional design that prioritizes learner diversity.

The findings signify a paradigm shift in higher education from reactive accommodations toward proactive inclusivity. The success of UDL integration within a hybrid course demonstrates that accessibility is achievable through thoughtful design rather than specialized interventions. This outcome serves as evidence that inclusivity benefits all learners, not just those with disabilities, by normalizing diversity as a central principle of course development.

The study also reflects a broader trend in educational reform that values learner variability as an asset rather than a limitation. By embedding UDL in hybrid instruction,

universities move closer to realizing equitable education where participation, engagement, and achievement are attainable for all. The results therefore mark an important milestone in the transition toward universally accessible higher education.

The implications of this study extend beyond the course level to institutional and policy domains. The demonstrated effectiveness of UDL integration highlights the need for universities to embed inclusive design principles in curriculum development, instructional technology training, and quality assurance frameworks. Hybrid education models that adopt UDL can serve as scalable prototypes for accessibility reform across disciplines.

The findings also suggest practical implications for faculty development. Educators require targeted training to apply UDL principles effectively in hybrid settings. Incorporating UDL in professional development programs can enhance instructors' capacity to anticipate learner diversity and design more flexible and responsive course materials. Such initiatives will foster sustainable inclusivity within higher education ecosystems.

The strong improvement in accessibility and engagement stems from the alignment between UDL principles and the inherent flexibility of hybrid learning (Gökoğlu et al., 2025). Multiple means of representation allowed students to access information in visual, auditory, and textual formats, addressing differences in perception and comprehension (Nirwana An et al., 2025). Multiple means of engagement through collaborative tasks and self-paced learning fostered motivation and autonomy, while multiple means of expression empowered students to demonstrate knowledge in varied ways suited to their strengths.

The hybrid environment provided an ideal platform for implementing these principles by combining the interactivity of face-to-face sessions with the adaptability of digital tools. This synergy amplified the benefits of UDL, enabling inclusive participation without compromising academic standards (Shen et al., 2025). The findings suggest that inclusivity is best achieved when pedagogy and technology work in tandem under a coherent design framework.

Future research should expand the scope of UDL implementation across multiple courses and disciplines to assess generalizability and scalability. Longitudinal studies are needed to examine the sustained impact of UDL-based hybrid design on student retention, achievement, and self-efficacy. Investigations into faculty perceptions and institutional readiness would also provide valuable insights into systemic adoption barriers.

Practical implementation should focus on embedding UDL within institutional policies and digital infrastructure. Universities should establish inclusive design standards, promote cross-departmental collaboration, and allocate resources for ongoing training and evaluation. The success of this study underscores that accessibility is not an endpoint but a continuous commitment to designing learning environments that welcome and empower all students.

CONCLUSION

The most important finding of this study reveals that the integration of Universal Design for Learning (UDL) principles within a hybrid university course significantly enhances accessibility, engagement, and satisfaction among diverse student populations. The combination of multiple means of representation, engagement, and expression proved to reduce learning barriers while promoting flexibility and inclusion. This study identifies that accessibility in hybrid education is not solely dependent on technological sophistication but rather on pedagogical intentionality designing courses that anticipate learner variability. The distinctive aspect of this research lies in demonstrating that inclusivity can be operationalized as a proactive instructional design strategy, not merely as an accommodation for students with special needs.

The major contribution of this study is conceptual rather than methodological. It extends the theoretical application of UDL beyond traditional or fully online environments to hybrid higher education contexts, thereby expanding the discourse on inclusive digital pedagogy. The

findings advance understanding of how UDL principles can align with hybrid course structures to create equitable participation and engagement for all learners. By connecting UDL theory with practical instructional design, the research offers a replicable framework for educators and institutions aiming to enhance accessibility through intentional course redesign. This conceptual contribution also reinforces the relevance of inclusive design as a central component of 21st-century higher education reform.

The research is limited by its scope, focusing on a single course and a relatively small sample size within one institutional context. The hybrid model implemented may not fully capture the variability of technological infrastructure or cultural diversity across other universities. Future research should expand through multi-site studies, integrating quantitative and qualitative longitudinal analyses to measure long-term impacts of UDL on learning achievement, retention, and inclusivity. Investigations into faculty readiness, policy alignment, and digital infrastructure support would also strengthen the practical scalability of UDL-based hybrid learning across broader higher education systems.

AUTHOR CONTRIBUTIONS

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

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

Author 3: Data curation; Investigation.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

Aromoye, I. A., Lo, H. H., Sebastian, P., Ayinla, S. L., & Abro, G. E. M. (2025). Significant Advancements in UAV Technology for Reliable Oil and Gas Pipeline Monitoring. *Computer Modeling in Engineering & Sciences*, *142*(2), 1155–1197. https://doi.org/10.32604/cmes.2025.058598

Asghari, M., Emami Niri, M., & Sedaee, B. (2025). UHSNet: Deep learning-based smart proxy modeling for underground hydrogen storage. *Energy*, *329*, 136763. https://doi.org/10.1016/j.energy.2025.136763

Başer, A., & Şahin, H. (2025). An interprofessional education program based on the ARCS-V motivation model on the theme of "Chronic Disease Management and Patient Safety": Action research. *BMC Medical Education*, *25*(1), 532. https://doi.org/10.1186/s12909-025-07085-y

Bensalem, E., Derakhshan, A., Alenazi, F. H., Thompson, A. S., & Harizi, R. (2025). Modeling the Contribution of Grit, Enjoyment, and Boredom to Predict English as a Foreign Language Students' Willingness to Communicate in a Blended Learning Environment. *Perceptual and Motor Skills*, *132*(1), 144–168. https://doi.org/10.1177/00315125241289192

Chen, X., Wang, X., Wang, Y., Liu, D., & Zhang, W. (2025). Leveraging deep learning and graph analysis for enhanced course recommendations in online education. *Scientific Reports*, *15*(1), 18623. https://doi.org/10.1038/s41598-025-02156-y

Dai, Z., Yang, Y., Chen, Z., Wang, L., Zhao, L., Zhu, X., & Xiong, J. (2025). The role of project-based learning with activity theory in teaching effectiveness: Evidence from the internet of things course. *Education and Information Technologies*, *30*(4), 4717–4749. https://doi.org/10.1007/s10639-024-12965-9

Fischer, B., & Frennert, S. (2025). Towards an experiential ethics of AI and robots: A review of empirical research on human encounters. *Technological Forecasting and Social Change*, *219*, 124264. https://doi.org/10.1016/j.techfore.2025.124264

Fu, M., Basem, A., Samad, S., Bayz, D. A., Alhumaid, S., Dutta, A. K., Ali, H. E., Jastaneyah, Z., Alkhalaf, S., & Mahariq, I. (2025). Two-bed adsorption refrigeration cycle integration into a hybrid biomass-gasification multigeneration system for sustainable energy production: Comprehensive 4E analysis, and machine learning optimization. *Applied Thermal Engineering*, *281*, 128615. https://doi.org/10.1016/j.applthermaleng.2025.128615

Gökoğlu, S., Karaoğlan Yılmaz, F. G., & Yılmaz, R. (2025). Investigation of the effect of group cohesion, group atmosphere, transactive memory system, and social interaction space on online cooperative learning attitude. *Journal of Computers in Education*, *12*(2), 675–698. https://doi.org/10.1007/s40692-024-00326-x

Gu, X., Krish, M., Sohail, S., Thakur, S., Sabrina, F., & Fan, Z. (2025). From Integer Programming to Machine Learning: A Technical Review on Solving University Timetabling Problems. *Computation*, *13*(1), 10. https://doi.org/10.3390/computation13010010

Gupta, S., Dutta, S., Sarkar, T., Bhattacharya, A., Paul, C., & Roy, P. K. (2025). Solving multi-objective probabilistic optimal power flow with renewable energy sources and Battery energy storage in transmission networks using Quasi Oppositional Sine Cosine algorithm. *Journal of Energy Storage*, *122*, 116411. https://doi.org/10.1016/j.est.2025.116411

Hafdi, Z. S., & El Kafhali, S. (2025). A Comparative Evaluation of Machine Learning Methods for Predicting Student Outcomes in Coding Courses. *AppliedMath*, *5*(2), 75. https://doi.org/10.3390/appliedmath5020075

Han, I., Ji, H., Jin, S., & Choi, K. (2025). Mobile-based artificial intelligence chatbot for self-regulated learning in a hybrid flipped classroom. *Journal of Computing in Higher Education*. https://doi.org/10.1007/s12528-025-09434-8

Justice, P. D., Marshman, E., & Singh, C. (2025). A Framework for Understanding the Impact of Integrating Conceptual and Quantitative Reasoning in a Quantum Optics Tutorial on Students' Conceptual Understanding. *Education Sciences*, *15*(10), 1314. https://doi.org/10.3390/educsci15101314

Kabiru Sa'adu, S., Khe, C. S., Abd. Shukur, M. F., Chong, K. F., Lai, C. W., You, K. Y., Nik Roseley, N. R., & Aboelazm, E. (2025). Transition metal coordination polymer-derived materials for supercapacitor applications: Recent advances and future perspectives. *Royal Society Open Science*, *12*(8), 250919. https://doi.org/10.1098/rsos.250919

Kazanskiy, N. L., Golovastikov, N. V., & Khonina, S. N. (2025). The Optic Brain: Foundations, frontiers, and the future of photonic artificial intelligence. *Materials Today Physics*, *58*, 101856. https://doi.org/10.1016/j.mtphys.2025.101856

Lamb, J., Fawns, T., Noteboom, J., & Ross, J. (2025). Choreography and improvisation in hybrid teaching. *Higher Education Research & Development*, *44*(1), 98–115. https://doi.org/10.1080/07294360.2024.2435855

Li, W., Liu, X., Liu, L., Du, Q., Lin, D., Chen, X., He, D., Wang, S., Wu, Y., Wang, H., Jiang, S., Zhang, X., & Lu, Z. (2025). Revealing atomic strengthening mechanism in CoNiV medium-entropy alloy via machine learning-guided simulations. *Journal of Materials Science & Technology*, *238*, 66–77. https://doi.org/10.1016/j.jmst.2025.04.005

Lilhore, U. K., Simaiya, S., Alroobaea, R., Baqasah, A. M., Alsafyani, M., Alhazmi, A., & Khan, M. M. (2025). SmartTrust: A hybrid deep learning framework for real-time threat detection in cloud environments using Zero-Trust Architecture. *Journal of Cloud Computing*, *14*(1), 35. https://doi.org/10.1186/s13677-025-00764-7

Ma, G., Sun, B., Yuan, Q., & Yang, W. (2025). The connected vehicle microscopic behavior modeling base on risk field theory: Theoretical developments, methodological overview and future trends. *Physica A: Statistical Mechanics and Its Applications*, *668*, 130584. https://doi.org/10.1016/j.physa.2025.130584

Najjar, N., Rouphael, M., Bitar, T., & Hleihel, W. (2025). The rise and drop of online learning: Adaptability and future prospects. *Frontiers in Education*, *10*, 1522905. https://doi.org/10.3389/feduc.2025.1522905

Nirwana An, A., Rifai, A., Ali, M., Ali Mustofa, T., Nur Vambudi, V., Nur Rochim Maksum, Muh., & Umar Budihargo, M. (2025). SWOT Analysis of AI Integration in Islamic Education: Cognitive, Affective, and Psychomotor Impacts. *Qubahan Academic Journal*, *5*(1), 476–503. https://doi.org/10.48161/qaj.v5n1a1498

Palanisamy, B., Hassija, V., Chatterjee, A., Mandal, A., Chakraborty, D., Pandey, A., Chalapathi, G. S. S., & Kumar, D. (2025). Transformers for Vision: A Survey on Innovative Methods for Computer Vision. *IEEE Access*, *13*, 95496–95523. https://doi.org/10.1109/ACCESS.2025.3571735

Portillo, F., Soler-Ortiz, M., Sanchez-Cruzado, C., Garcia, R. M., & Novas, N. (2025). The Impact of Flipped Learning and Digital Laboratory in Basic Electronics Coursework. *Computer Applications in Engineering Education*, *33*(1), e22810. https://doi.org/10.1002/cae.22810

Qiu, Y., Meng, J., & Li, B. (2025). Semi-supervised Strong-Teacher Consistency Learning for few-shot cardiac MRI image segmentation. *Computer Methods and Programs in Biomedicine*, *261*, 108613. https://doi.org/10.1016/j.cmpb.2025.108613

Rakhshani, S., Arbab, A., Habibi, A., Pourazizi, M., Tajmirriahi, M., Sedighin, F., & Rabbani, H. (2025). Self-supervised model-informed deep learning for low-SNR SS-OCT domain transformation. *Scientific Reports*, *15*(1), 17791. https://doi.org/10.1038/s41598-025-02375-3

Shen, X., Zhang, H., Li, J., Du, C., Yu, Z., Cui, Y., Fang, Y., & Wang, Z. (2025). State of power estimation for LIBs in electric vehicles: Recent progress, challenges, and prospects. *Journal of Energy Storage*, *115*, 116042. https://doi.org/10.1016/j.est.2025.116042

Soos, I., Whyte, I., Szekeres, D., Ozsvath, K., Szabo, A., Ling, J., Jiménez-Parra, J. F., & Valero-Valenzuela, A. (2025). The Role of Motivation to Promote Personal and Social Responsibility Through PE and Sport: A Comparative Exploratory Investigation of Prospective PE Teachers and Sports Leaders in Hungary and Spain. *Physical Activity and Health*, *9*(1), 1–15. https://doi.org/10.5334/paah.403

Suchandra, H., Maheshwari, P., Patley, R., G, R., Harshitha, N. R., Subramaniyan, S., Jain, S., Manjunatha, N., Kumar, C. N., & Math, S. B. (2025). Technology-driven innovative model for integrating mental healthcare into primary care: Example from Chhattisgarh, India. *Psychiatry Research*, *349*, 116533. https://doi.org/10.1016/j.psychres.2025.116533

Tesán, L., González, D., Martins, P., & Cueto, E. (2025). Thermodynamics-informed graph neural networks for real-time simulation of digital human twins. *Computational Mechanics*, *76*(3), 923–944. https://doi.org/10.1007/s00466-025-02633-1

Vargas Portillo, P. (2026). The transformative role of artificial intelligence in leadership and management development: An academic insight. *Development and Learning in Organizations: An International Journal*, *40*(1), 1–4. https://doi.org/10.1108/DLO-10-2024-0301

Wang, Y., Feng, J., Wu, J., Song, J., Li, Y., Bai, L., Qi, L., & Zhang, Z. (2025). Self-powered and self-sensing triboelectric electromagnetic hybrid generator with dual motion amplification mechanism for application in floating slab track system. *Nano Energy*, *135*, 110663. https://doi.org/10.1016/j.nanoen.2025.110663

Wei, Z., Hassan, N. C., Hassan, S. A., Ismail, N., Gu, X., & Dong, J. (2025). The relationship between Internet addiction and academic burnout in undergraduates: A chain mediation model. *BMC Public Health*, *25*(1), 1523. https://doi.org/10.1186/s12889-025-22719-y

Wu, D., Liang, Q.-Q., Hu, B.-X., Zhang, Z.-T., Wang, X.-F., Jiang, J.-J., Yi, G.-W., Zeng, H.-Y., Hu, J.-Y., Yu, Y., & Zhang, Z.-R. (2025). Research Progress of Event Intelligent Perception Based on DAS. *Sensors*, *25*(16), 5052. https://doi.org/10.3390/s25165052

Xie, X., Zhang, L. J., & Wilson, A. J. (2025). Comparing ChatGPT Feedback and Peer Feedback in Shaping Students' Evaluative Judgement of Statistical Analysis: A Case Study. *Behavioral Sciences*, *15*(7), 884. https://doi.org/10.3390/bs15070884

Zheng, L., & Wei, W. (2025). Traffic conflict-based crash risk estimation: Machine learning meets extreme value theory. *Transportmetrica A: Transport Science*, 1–29. https://doi.org/10.1080/23249935.2025.2477261