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## Designing a Cloud-Based Ubiquitous Learning Environment for a Hybrid University Language Course

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### ABSTRACT

**Background.** The rise of hybrid learning models in higher education has highlighted the need for flexible, scalable, and context-aware digital learning environments capable of supporting continuous language learning beyond classroom boundaries.

**Purpose.** This study aims to design and evaluate a cloud-based ubiquitous learning environment tailored for a hybrid university language course to enhance learner autonomy, engagement, and communicative competence.

**Method.** Employing a design-based research methodology, the study involved iterative cycles of analysis, design, implementation, and evaluation with 42 undergraduate language learners. Data were collected through system usage analytics, pre- and post-course proficiency assessments, and learner experience surveys.

**Results.** The results indicate significant improvements in vocabulary retention, listening comprehension, and task-based communication skills, accompanied by increased learner satisfaction with the flexibility and responsiveness of the system.

**Conclusion.** The study concludes that a cloud-based ubiquitous learning environment can meaningfully enhance hybrid language instruction by integrating mobility, accessibility, and real-time support into traditional course structures.

### KEYWORDS

Hybrid Education, Mobile-Assisted, Ubiquitous Learning

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### INTRODUCTION

Ubiquitous learning has emerged as a significant paradigm in contemporary education, characterized by seamless, anytime anywhere access to learning resources through cloud technologies and mobile devices. The expansion of high-speed internet connectivity and the proliferation of smart devices have made it increasingly possible for learners to engage with instructional content continuously, regardless of physical location. This shift has encouraged educators to rethink traditional boundaries of learning environments (Puthal et al., 2024). Hybrid learning models have gained traction in higher education because they combine the strengths of face-to-face instruction with the flexibility of digital learning. Research indicates that hybrid formats enhance student engagement,



promote deeper learning, and allow personalized pathways for diverse learners. The integration of synchronous and asynchronous modes also enables learners to review materials, communicate, and collaborate at their own pace.

Cloud-based platforms play a central role in supporting hybrid learning by offering shared storage, collaborative workspaces, and scalable architecture. These systems allow real-time content delivery, immediate feedback, and multimodal interaction. Studies have shown that cloud-based learning environments can enhance collaboration and autonomy, particularly in language learning contexts where frequent practice is essential (Auer et al., 2024a; Perakovic & Knapcikova, 2025). Language learning requires consistent exposure, contextual practice, and opportunities for communication that extend beyond traditional classroom time. Mobile-assisted language learning research suggests that learners benefit from on-demand access to vocabulary exercises, communicative tasks, and authentic materials. Cloud-based ubiquitous learning aligns closely with these needs by enabling persistent access to such resources.

Educators increasingly recognize that ubiquitous learning environments encourage learner-centered pedagogies. The shift from teacher-directed instruction to more self-regulated learning is supported by technological affordances that allow monitoring, personalized feedback, and adaptive learning pathways. These developments reflect broader trends toward digital transformation in higher education. Empirical evidence demonstrates that ubiquitous learning supports continuity across diverse learning contexts. Students can transition smoothly between formal lessons, independent study, and spontaneous learning opportunities. This continuity is essential in language acquisition, where repeated and varied exposure significantly influences proficiency development (Auer et al., 2024b; Ramesh Babu et al., 2023).

Despite the growing interest in ubiquitous learning, little is known about the pedagogical design of cloud-based ubiquitous environments specifically tailored for hybrid university language courses. Existing studies often focus on technological features rather than the instructional models necessary to integrate these tools meaningfully within a curriculum. The lack of design-oriented research limits practical implementation. The mechanisms through which ubiquitous learning environments influence language proficiency remain underexplored. Few studies examine how mobile access, real-time feedback, and cloud-supported collaboration interact to support vocabulary acquisition, listening comprehension, or communicative competence. This gap restricts understanding of how ubiquitous learning contributes to measurable outcomes (Jha et al., 2023; Wang et al., 2024).

Learner perceptions and experiences in hybrid ubiquitous environments have not been fully documented. Questions remain about how students navigate multiple learning spaces, manage self-regulated learning responsibilities, and perceive the usability of cloud-based tools. Without insight into learner perspectives, the development of effective instructional design remains incomplete. The long-term sustainability and scalability of cloud-based ubiquitous learning models remain unclear. Institutions require evidence on how such systems function operationally, how they affect teacher workload, and how they influence learner autonomy across semesters. The absence of longitudinal and pragmatic data leaves a critical gap in knowledge for higher education stakeholders.

Addressing these gaps is essential for developing effective hybrid language instruction that leverages the full potential of cloud-based ubiquitous learning. A design-oriented approach can reveal how technological affordances, pedagogical strategies, and learner behaviors interact to shape meaningful learning experiences. Understanding these interactions is crucial for constructing environments that support both guided and autonomous language learning. A systematic examination of cloud-supported ubiquitous learning can inform theoretical and practical

advancements. This research seeks to articulate a design framework that integrates mobility, real-time feedback, and hybrid instructional strategies to enhance linguistic development. The study hypothesizes that a cloud-based ubiquitous learning environment will improve learner engagement, language proficiency, and continuity between online and face-to-face activities (Kim et al., 2023; Liu et al., 2023).

The purpose of this study is to design, implement, and evaluate a cloud-based ubiquitous learning environment specifically created for a hybrid university language course. The research aims to provide empirical evidence and pedagogical guidelines for integrating ubiquitous learning into higher education language programs. This work contributes to the development of scalable, flexible, and learner-centered digital ecosystems that meet the evolving demands of contemporary language education (Kline, 2023; Lee & Huang, 2024).

## RESEARCH METHODOLOGY

The study adopted a design-based research (DBR) methodology to develop and evaluate a cloud-based ubiquitous learning environment for a hybrid university language course. This research design was selected because DBR allows iterative cycles of analysis, design, implementation, and refinement, enabling researchers to examine learning processes in authentic educational contexts while improving the instructional intervention in real time. The approach emphasizes collaboration between researchers, instructors, and learners, ensuring that technological and pedagogical considerations evolve simultaneously. The DBR framework provided a systematic structure for addressing both the theoretical and practical objectives of the study (Prabhu et al., 2025; Shi et al., 2023).

The population consisted of undergraduate students enrolled in a university-level English language course that followed a hybrid instructional model. The sample included 42 students selected through purposive sampling to ensure representation of diverse proficiency levels and differing levels of technological familiarity. Participants were required to have regular access to mobile devices and stable internet connectivity to engage with the ubiquitous learning environment. The sample size allowed for meaningful evaluation of system usage patterns, learning performance, and usability perceptions while ensuring feasibility for iterative DBR cycles (Chład & Ogiela, 2023; P. Singh et al., 2023).

The study utilized a combination of quantitative and qualitative instruments to collect comprehensive data on learning performance, system interaction, and user experience. Quantitative measures included pre- and post-tests assessing vocabulary, listening comprehension, and task-based communication skills. System analytics recorded log-in frequency, task completion rates, time-on-task, and device usage (Kathane & Sharma, 2023; Sudharsanan et al., 2024). Qualitative data were gathered through semi-structured interviews, open-ended reflection journals, and classroom observations to capture learners' perceptions of usability, autonomy, and continuity across learning contexts. The triangulation of instruments enhanced the validity of findings by linking performance outcomes with behavioral and experiential evidence.

The research procedures followed four DBR cycles, each comprising needs analysis, prototype design, implementation, and evaluation. The needs analysis involved identifying pedagogical challenges in the hybrid course and determining desired features for a cloud-based ubiquitous learning environment. The design phase translated these needs into functional system components such as mobile-accessible tasks, real-time feedback mechanisms, and integrated communication spaces. The implementation phase deployed the prototype within the hybrid course, where students engaged with cloud-based tasks before, during, and after face-to-face sessions. The

evaluation phase employed mixed-methods analysis to identify strengths, limitations, and areas for refinement, informing subsequent redesigns. The structured cycles ensured that both pedagogical and technological elements evolved coherently and responsively to learner needs (Dobie & Holder, 2024; Ooi et al., 2023).

## RESULT AND DISCUSSION

The quantitative dataset consisted of pre-test and post-test scores from 42 students measuring vocabulary acquisition, listening comprehension, and task-based communication performance within the hybrid course. Descriptive statistics revealed notable improvements across all competencies. Vocabulary scores increased from a mean of 61.3 to 78.4, listening comprehension rose from 58.7 to 81.2, and task-based communication improved from 55.9 to 79.5. Standard deviations narrowed across measures, indicating increased consistency in learner performance after engagement with the cloud-based ubiquitous learning environment.

Usage analytics collected from the cloud platform documented high levels of learner interaction. Students logged into the system an average of 4.8 times per week and completed 92% of assigned mobile-accessible tasks. Time-on-task data showed that learners spent an average of 37 minutes per session engaging with cloud-based exercises. The learning environment supported real-time tracking, enabling detailed measurement of engagement patterns and highlighting continuous use across formal and informal contexts.

**Table 1.** Descriptive statistics of language learning performance (n = 42)

Indicator	Pre-test Mean	Post-test Mean	Gain Score
Vocabulary Acquisition (%)	61.3	78.4	+17.1
Listening Comprehension (%)	58.7	81.2	+22.5
Task-Based Communication (0-100)	55.9	79.5	+23.6

The descriptive data indicate that the cloud-based ubiquitous learning environment effectively enhanced learners' engagement with language tasks beyond the classroom. The flexible nature of the platform enabled continuous exposure to language inputs through mobile-accessible materials, which likely contributed to improved vocabulary retention and listening comprehension. The high task completion rate suggests that learners perceived the environment as accessible and manageable within their daily routines. Task-based communication gains may be attributed to the system's integration of multimodal activities, real-time feedback functions, and mobile-supported collaboration spaces. Learners interacted with language tasks more frequently and with greater autonomy, enabling repeated practice and reinforcement. These features helped strengthen communicative competence by providing authentic, contextually relevant scenarios accessible across devices.

The qualitative dataset included 84 reflective journals, 42 interview transcripts, and observational notes documenting learner experiences with the ubiquitous learning system. Students reported that the cloud-based platform supported flexible learning, allowing them to study during commutes, breaks, or at home. Learners emphasized that mobile accessibility reduced feelings of pressure associated with rigid schedules, giving them more control over their learning pace. Interview responses highlighted that real-time feedback and seamless transitions between online and offline activities increased learner confidence. Students noted that the system promoted more frequent practice, as they could complete tasks in short intervals throughout the day. Many

described the environment as “fluid,” “continuous,” and “supportive,” reflecting strong alignment between system capabilities and learner expectations.

A paired-sample t-test was conducted to assess the significance of performance gains. The results showed statistically significant improvements across all indicators: vocabulary acquisition ( $t = 10.14$ ,  $p < 0.001$ ), listening comprehension ( $t = 12.87$ ,  $p < 0.001$ ), and task-based communication ( $t = 11.56$ ,  $p < 0.001$ ). The effect sizes ranged from 0.82 to 0.95, indicating high practical significance and confirming the pedagogical value of the cloud-based ubiquitous learning environment.

Inferential patterns demonstrate uniform improvement among students regardless of initial proficiency levels. The strong linguistic gains suggest that the environment effectively supported personalized learning by allowing students to access adaptive materials anytime and anywhere. The results validate the design principles employed in the platform, indicating that ubiquitous learning has substantial potential for enhancing hybrid language instruction.

**Table 2.** Paired-sample t-test results

Indicator	t-value	p-value	Effect Size (d)
Vocabulary Acquisition	10.14	<0.001	0.82
Listening Comprehension	12.87	<0.001	0.90
Task-Based Communication	11.56	<0.001	0.95

A strong relationship was found between system usage frequency and learning gains. Students who accessed the cloud environment at least five times per week demonstrated approximately 30% greater improvement than those with fewer than three weekly logins. The correlation coefficient ( $r = 0.71$ ) suggests a robust connection between active engagement and language performance, reinforcing the value of continuous learning opportunities. Another relational pattern emerged between time-on-task and listening comprehension gains. Learners who spent more than 40 minutes per session recorded significantly higher comprehension scores. These findings suggest that extended exposure to audio-rich content within the ubiquitous learning environment strengthens listening skills by reinforcing auditory processing and comprehension strategies.

A detailed case study of a high-performing participant revealed that consistent use of mobile tasks and real-time feedback features contributed to rapid linguistic improvement. This learner frequently engaged with vocabulary quizzes, collaborative discussion forums, and listening modules during spare moments outside class time. Their interview responses emphasized satisfaction with the system’s flexibility and sense of constant linguistic immersion. A contrasting case involved a participant who exhibited minimal improvement. This learner rarely accessed the system outside scheduled sessions and reported difficulty maintaining motivation for self-regulated learning. Interview insights revealed struggles with time management and limited familiarity with cloud-based applications. These findings suggest that learner autonomy and digital readiness significantly influence outcomes within ubiquitous learning environments.

The case study comparisons show that ubiquitous learning environments amplify individual learning behaviors. Learners who demonstrated proactive study habits and embraced mobile-supported tasks experienced significant gains, while those with limited engagement benefitted far less. This pattern reinforces the importance of self-regulation and digital literacy when integrating ubiquitous learning strategies. The effectiveness of the environment appears tied to its alignment with learners’ everyday routines. The ability to access tasks anytime and anywhere allowed language learning to integrate naturally into daily life. The design of seamless transitions between

hybrid sessions and cloud-based tasks supported sustained cognitive engagement and expanded opportunities for authentic practice.

The overall findings suggest that a cloud-based ubiquitous learning environment meaningfully enhances hybrid language learning by extending instructional opportunities across formal and informal contexts. Learners demonstrated significant linguistic improvement, strong engagement patterns, and positive attitudes toward the system's flexibility and responsiveness. The design succeeded in supporting continuity of learning, a core principle of ubiquitous learning. The results indicate that such environments hold strong potential for future language instruction models, offering scalable, adaptable, and learner-centered solutions. The study provides compelling evidence that ubiquitous learning can bridge gaps between classroom-based and autonomous learning, reinforcing hybrid pedagogy with continuous, mobile-supported engagement.

The study revealed that designing a cloud-based ubiquitous learning environment for a hybrid university language course led to substantial improvements in vocabulary acquisition, listening comprehension, and task-based communication. Quantitative data showed statistically significant gains across all indicators, confirming that students benefitted linguistically from sustained, flexible access to digital learning materials. The narrowing standard deviations indicated greater consistency in student achievement over time. Learner interaction logs demonstrated high levels of engagement, with frequent system access and strong task completion rates. Students used the platform regularly throughout the week, indicating that the cloud-based environment supported continuity between face-to-face and online sessions. Engagement patterns suggested that learners adopted the system as part of their daily routines, validating the intent of ubiquitous learning design.

Qualitative findings revealed that students perceived the learning environment as convenient, motivating, and supportive of autonomous learning. Reflections and interview data highlighted increased confidence in managing language learning tasks independently. Many students identified the platform's real-time feedback and mobile accessibility as key contributors to their learning progress. The triangulated evidence suggests that the ubiquitous learning environment effectively bridged the gap between structured classroom instruction and flexible self-directed practice. The combination of multimodal resources, adaptive access, and seamless integration into hybrid pedagogy produced measurable linguistic and behavioral gains that underscored the success of the design.

The findings align with earlier research demonstrating the effectiveness of mobile-assisted and cloud-supported language learning in promoting continuous engagement and improved proficiency. Previous studies have noted that ubiquitous learning environments enhance learner autonomy and increase opportunities for practice. This study confirms these benefits while extending them within a hybrid education framework. Significant differences emerge in the degree of improvement observed, especially in listening comprehension and task-based communication. Earlier research often emphasized vocabulary gains, whereas this study demonstrates broader linguistic enhancement. The integrated cloud-based system may have contributed to more robust outcomes by providing real-time resources, interactive activities, and learning continuity across contexts.

The study differs from many prior investigations that framed ubiquitous learning primarily as a technological solution. The present research emphasizes pedagogical design, demonstrating that technological affordances must be aligned with instructional goals to produce meaningful learning outcomes. This alignment distinguishes the study from purely technology-driven models that overlook pedagogical coherence. The findings also diverge from earlier concerns regarding learner overload in ubiquitous systems. Students in this study reported high usability and minimal cognitive

strain, likely due to the deliberate structuring of tasks and intuitive interface design. This contrast highlights the role of thoughtful design in mitigating challenges commonly associated with ubiquitous learning environments.

The findings indicate a significant shift in how students interact with learning materials in hybrid contexts. Learners incorporated the platform into their daily routines, showing that ubiquitous access encourages distributed practice rather than isolated study sessions. This shift suggests that cloud-based environments can reshape learning behaviors in sustainable ways. The results also indicate that ubiquitous learning environments can democratize access to high-quality instructional support. Students engaged with the system outside traditional class times, gaining opportunities for repeated exposure and self-regulated learning. This pattern reflects the potential for cloud-based systems to supplement instruction in ways that reduce reliance on fixed schedules.

Improved performance in listening comprehension and task-based communication suggests that mobile-supported tasks create authentic learning opportunities aligned with real-life language use. Learners practiced comprehension and communication in varied contexts, indicating that ubiquitous environments promote situated learning that is difficult to achieve in conventional classrooms. The alignment between learner perceptions and performance outcomes indicates that ubiquitous learning environments foster both cognitive and affective gains. Students felt more confident, motivated, and autonomous, demonstrating that the environment supported psychological readiness for learning. This dual impact is a key indicator of the environment's pedagogical value.

The findings have important implications for hybrid language course design. Educators can integrate cloud-based ubiquitous learning systems to extend instructional time beyond the classroom, enabling students to engage in continuous practice. Such integration may enhance linguistic performance and support individualized learning trajectories. The results suggest that universities should invest in cloud infrastructures that support scalable, device-agnostic access to learning materials. Institutional support for ubiquitous learning could improve student engagement, reduce attrition in language courses, and promote consistent practice. This infrastructural commitment aligns with global trends toward digital transformation in higher education.

The study highlights implications for pedagogy, emphasizing the need for hybrid models that strategically combine in-person instruction with ubiquitous digital resources. Teachers may shift from content transmitters to facilitators guiding students through personalized learning pathways. This pedagogical transition could increase student responsibility and autonomy in language learning. The positive learner perceptions suggest that ubiquitous learning environments may enhance student satisfaction and motivation (Cai et al., 2024; Matsui et al., 2023). Educational institutions can leverage this affective dimension to design courses that promote sustained engagement, even in demanding academic contexts. Such outcomes are critical for improving long-term language proficiency.

The significant improvements occurred because the ubiquitous system allowed learners to engage with content repeatedly and flexibly, strengthening memory retention and skill development. Continuous, mobile-supported exposure provided opportunities for distributed practice, a well-established factor in effective language learning. The cloud environment facilitated consistent reinforcement. The design of the platform encouraged autonomy and self-regulation, which contributed to improved linguistic outcomes. Students could choose when and how to interact with tasks, allowing them to tailor learning activities to their personal schedules and preferences. This flexibility enhanced motivation and reduced the cognitive burden of rigid learning structures.

The seamless integration of online and face-to-face activities promoted cognitive continuity. Learners were able to revisit materials introduced in class and apply them in mobile exercises throughout the week. This continuity reinforced learning and contributed to stronger performance in communication tasks that require integrated skills (Hamzehei et al., 2023; Matsui et al., 2023). The high usability of the platform played a central role in supporting engagement. Students reported that the interface was intuitive and accessible, enabling smoother transitions between contexts. The reliability of the system helped learners build consistent study routines, contributing to measurable improvements across performance indicators (Shankar et al., 2025; Vettenburg & Valantinas, 2024).

Future research should investigate the long-term impact of ubiquitous learning environments on language proficiency, examining retention rates and performance trajectories over several semesters. Longitudinal studies would provide deeper insight into whether distributed, cloud-supported practice leads to durable learning gains. These findings would inform sustainable hybrid course design. Further exploration is needed to determine how ubiquitous learning environments support different proficiency levels. Studies could examine how novice, intermediate, and advanced learners engage with cloud-based systems and which design features best meet their needs. Differentiated analysis would enable more precise instructional design (Nkongolo & Tokmak, 2023; Puertas-Aguilar et al., 2023).

Teacher training is an essential next step. Instructors must learn to integrate ubiquitous learning tools strategically, interpret system analytics, and create hybrid tasks that complement cloud-based activities. Professional development programs should focus on pedagogical, technical, and assessment-related competencies for hybrid course implementation. At the institutional level, universities should evaluate digital equity and accessibility issues. Ensuring that all students have reliable access to cloud-based learning systems is essential for maximizing learning opportunities. Institutional investment in infrastructure, support services, and inclusive design will be necessary for scaling ubiquitous learning environments (Hui et al., 2023; N. K. Singh et al., 2024).

## CONCLUSION

The most important finding of this study is the evidence that a cloud-based ubiquitous learning environment can meaningfully transform learner engagement and performance in a hybrid university language course by enabling continuous, distributed, and context-rich learning. The study demonstrates a distinct outcome compared with previous technology-assisted language learning research, specifically by showing how seamless transitions between face-to-face instruction and mobile-supported autonomous learning yield improvements across multiple linguistic domains, including vocabulary, listening comprehension, and task-based communication skills. This integrated effect highlights the unique pedagogical value of consciously designed ubiquitous learning systems rather than merely adopting digital tools for convenience.

The research contributes added value by introducing a design-based methodological approach that aligns technological affordances with pedagogical goals and authentic classroom needs. The study offers a conceptual advancement by framing cloud-based ubiquitous learning as an ecosystem rather than a collection of isolated digital tools, emphasizing mobility, accessibility, synchronous asynchronous integration, and sustained learner autonomy. The methodological contribution lies in its multi-source evaluation strategy combining system analytics, performance assessments, and learner reflections which provides a comprehensive model for assessing ubiquitous learning interventions. These contributions enrich the literature on hybrid pedagogy, mobile-assisted language learning, and educational technology design.

The study is limited by its relatively modest sample size, short intervention duration, and reliance on a single institutional context, which constrains the generalizability of the findings. Future research should examine long-term learning trajectories, expand implementation across multiple universities, and explore how different learner profiles respond to ubiquitous learning environments. Further investigation is needed into the roles of teacher training, digital equity, and cross-platform interoperability to strengthen the scalability and sustainability of cloud-based ubiquitous learning systems. These directions can inform more robust theoretical models and practical guidelines for hybrid language education.

## AUTHORS' CONTRIBUTION

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

Author 2: Conceptualization; Data curation; Investigation.

Author 3: Data curation; Investigation.

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

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