Title

"Enhancing Learning Outcomes for Students with Diverse Learning Needs in a HyFlex Environment: Insights from CompTIA A+ Certification Preparation"

Abstract (1500 characters max)

This paper examines the implementation of the HyFlex (Hybrid) teaching model to prepare students with diverse learning needs for the CompTIA A+ Certification. Combining in-person and remote instruction, the HyFlex model was introduced during and after the COVID-19 pandemic to create flexible learning environments that address varied student needs. Data were collected from six HyFlex courses conducted between Summer 2020 and Spring 2023, involving 34 Deaf and Hard of Hearing (DHH) students with different linguistic backgrounds and communication preferences.

The study highlights HyFlex's benefits, including increased flexibility, improved technology access, and higher student engagement (Penrod, 2022; Freeman & Urbaczewski, 2020). Challenges such as technological barriers, pedagogical limitations, and unequal learning experiences also emerged. Conducted before the widespread adoption of AI in education, this study suggests that AI integration could further enhance accessibility and support student success through adaptive learning platforms and personalized feedback.

The authors' findings demonstrate that HyFlex models effectively prepared students with diverse learning needs for technical certifications, providing adaptable and flexible learning options. Additionally, they underscore AI’s potential to address accessibility and engagement challenges, paving the way for more inclusive educational environments.

Introduction (250-500 words)

This paper examines the effectiveness of the HyFlex instructional model in preparing students with diverse learning needs, focusing on students pursuing CompTIA A+ certification. HyFlex, or Hybrid-Flexible, combines in-person and online synchronous instruction, giving students the flexibility to choose their preferred participation method. This flexible approach enhances accessibility, supporting various learning needs, preferences, and individual circumstances. Research has shown that HyFlex instruction can improve engagement, accommodate different learning styles, and create personalized educational experiences. For Deaf and Hard of Hearing (DHH) students, it offers specific benefits by enabling direct instruction, real-time access to interpreters, captioning, and other assistive technologies that facilitate equal participation, regardless of location (Freeman & Urbaczewski, 2020; Detyna et al., 2022).

This study also highlights how adaptive technologies, including artificial intelligence (AI), can further enhance HyFlex learning environments. With the advent of AI, tools like real-time captioning, sign language recognition, and personalized feedback systems offer new ways to support DHH students' unique communication needs and engagement levels. AI-driven learning paths allow for more customized support and real-time responses, making HyFlex models even more adaptable to diverse learner needs (Su & Weng, 2021; Pedró et al., 2020).

By exploring the combined potential of HyFlex and AI, this research contributes to the evolving discourse on educational technology. As adaptive and AI-enhanced teaching methods continue to emerge, educators have an opportunity to meet the varied needs of all students, strengthening both traditional and hybrid instructional models and paving the way for a more inclusive learning environment (Crompton & Burke, 2023).

Methodology (250-500 words)

This study used a mixed-methods design, combining quantitative and qualitative data to assess the impact of the HyFlex model on students with diverse needs, especially Deaf and Hard of Hearing (DHH) learners, as they prepared for the CompTIA A+ certification. This approach offered a detailed view of student performance, engagement, and satisfaction within the HyFlex instructional framework (Detyna et al., 2022; Freeman & Urbaczewski, 2020).

The study included 34 unique students across six courses between 2020-2023, each given the option to attend in person or remotely via Zoom. Among these, 31% were native ASL users, 41% were English users, and 28% used a combination of English/ASL, demonstrating a range of linguistic backgrounds. To support accessibility, the instructor used Simultaneous Communication (SimCom) for live sessions and added Zoom captioning and ASL interpretation for remote sessions, meeting the preferences of DHH students who favor ASL over SimCom (Carpenter et al., 2020; Hew & Cheung, 2014). The demographic data also revealed a diverse composition of learners, including both matriculated students and alumni, who brought a range of real-world demands into the course. Among participants, 40% were employed full-time, 28% were currently enrolled as full-time students, and 25% were job-seeking. This blend of professional, academic, and transitional circumstances underscore the flexibility needed to accommodate varied engagement levels and highlight the inclusive nature of the HyFlex model, allowing alumni and current students to participate seamlessly (Kemp & Grieve, 2014; Ubell, 2017) and engage based on personal needs (Crompton & Burke, 2023). Data were collected through surveys, performance metrics, and participant feedback over two academic years (2020-2023) across six courses, involving 34 DHH students.

Quantitative data included metrics on pass rates, hands-on tasks, quizzes, and final exams to evaluate academic performance. Engagement was measured through attendance, participation in live sessions, and use of asynchronous resources like recorded lectures. This allowed for an

objective assessment of academic success across in-person and remote settings (Diloreto et al., 2022; Radovan & Radovan, 2024).

Qualitative data were collected through surveys and semi-structured interviews. Surveys used Likert-scale questions to gauge satisfaction with instructional methods, accessibility, and the usefulness of tools like Zoom and WhatsApp. Open-ended questions in surveys and interviews probed perceived benefits and challenges, with a focus on accessibility and engagement. Questions also explored preferences for learning modalities, especially among DHH students using accessibility tools like ASL interpreters and Zoom captioning (Borgioli, 2019; Carpenter et al., 2020).

The technology used included Zoom for live sessions, WhatsApp for asynchronous communication, laptops or desktop computers, dual monitors, and webcams for sign language interpretation. These tools enabled active participation, such as marking content via Zoom's annotation feature, which promoted both in-person and remote engagement (Dziuban et al., 2018; Jaggars, 2020).

This mixed-methods approach provided a nuanced view of how HyFlex can meet varied needs, revealing specific technological and instructional strategies for optimizing hybrid learning environments (Detyna et al., 2022; Pedró et al., 2020).

Results (250-500 words)

The study's findings suggest that the HyFlex model was beneficial for most students, particularly in terms of flexibility, accessibility, and overall satisfaction. Of the 34 participants, 85% passed their CompTIA A+ certification by the third year, reflecting a marked improvement in student performance over time. This increase in pass rates, from 70% in the first year to 85% by the third year, aligns with similar findings in HyFlex research, where consistent support and structured engagement contribute to successful outcomes.

The analysis of surveys and interviews revealed the following key themes: Satisfaction, Engagement and Accessibility, and Hands-on Tasks.

Satisfaction: A total of 30 out of 34 students expressed satisfaction with their performance, attributing success to the flexibility and resources offered by the HyFlex model. Many students specifically praised the use of WhatsApp for ongoing discussions and Zoom for real-time captioning as pivotal elements that enhanced their learning experience (Jaggars, 2020). Furthermore, 80% reported feeling more in control of their learning pace due to the ability to toggle between in-person and online modes.

Engagement and Accessibility: While engagement was generally high, especially among in-person attendees, remote learners faced unique challenges. Qualitative feedback revealed that distractions at home—such as family obligations and connectivity issues—impacted remote learners' engagement. Students who preferred ASL interpretation noted a slight lag in the real-

time captioning tools, suggesting that improvements in digital accessibility features could further optimize learning experiences (Borgioli, 2019).

Hands-On Tasks: A notable performance difference was observed between in-person and remote students on hands-on technical tasks. In-person attendees demonstrated higher engagement and success rates in practical activities, suggesting that HyFlex models benefit from additional support structures for remote learners in hands-on disciplines (Alarifi & Song, 2024; Freeman & Urbaczewski, 2020).

Discussion (250-500 words)

The results of this study align with existing research on DHH education and the HyFlex learning model, highlighting both its strengths and challenges. The flexibility provided by HyFlex was particularly valuable for students with diverse learning needs, allowing them to engage with course content in ways that best suited their circumstances and preferences (Freeman & Urbaczewski, 2020). Detyna et al. (2022) similarly observed that HyFlex learning offers adaptable, inclusive options that improve student satisfaction and accessibility. However, the study also underscored challenges, particularly regarding disparities in access to resources and technological difficulties, which remote students faced. Common issues included unstable internet connections, limited access to hands-on training resources, and varied engagement levels, which reflect the challenges found in similar HyFlex studies (Jaggars, 2020; Kemp & Grieve, 2014).

As artificial intelligence (AI) in education continues to develop, it offers promising solutions to these challenges. AI-powered tools such as adaptive learning platforms, real-time captioning, and virtual simulation software can bridge the gap between in-person and remote learning, delivering personalized feedback and support tailored to individual students' needs (Su & Weng, 2021; Crompton & Burke, 2023). The potential for AI to enhance accessibility in education is particularly significant for DHH students, as it could automate captioning, sign language recognition, and adaptive feedback systems (Carpenter et al., 2020; Dziuban et al. 2018) further support the use of AI and emerging technologies to facilitate engagement and inclusion in hybrid and blended learning environments.

These findings underscore the importance of robust faculty development programs focused on building educators' proficiency with both AI and traditional technologies. As Pedró et al., 2020 highlight, comprehensive training in educational technology is essential for instructors to create equitable, adaptive learning experiences. Professional development programs should equip educators to support diverse learning needs across all modalities, ensuring students with disabilities are prepared for technical careers in an inclusive educational environment (Hew & Cheung, 2014; Ubell, 2017).

Conclusion (150-250 words)

The HyFlex model shows significant potential for improving educational outcomes, especially for students with diverse learning needs in technical certification programs like the CompTIA A+. By allowing students to choose their mode of engagement, HyFlex has been shown to positively impact both engagement and performance (Freeman & Urbaczewski, 2020; Hew & Cheung, 2014). However, this study also underscores the need to address ongoing challenges in equitable access, particularly for students with disabilities who often depend on specialized technologies to fully participate in hybrid environments (Detyna et al., 2022; Kemp & Grieve, 2014). Thus, the HyFlex approach not only meets the technical and pedagogical requirements of hybrid education but also promotes sustainable, long-term engagement, offering distinct advantages for underrepresented groups.

Looking forward, integrating AI into HyFlex models could further support inclusivity and success. Adaptive learning platforms and AI-driven tools, such as real-time captioning and personalized feedback systems, hold the potential to address many barriers that hinder remote learning experiences for students with disabilities (Crompton & Burke, 2023; Su & Weng, 2021). Continued investment in technology and faculty development remains essential to fully realize HyFlex's potential in preparing all students, particularly those with diverse learning needs, for technical careers (Penrod, 2022).

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