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Embracing inclusivity and flexibility in higher education: A study of HyFlex delivery and its impact on diverse undergraduates in the post-pandemic era

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Abstract

In the wake of the COVID-19 pandemic, higher education has undergone a significant transformation, necessitating a re-evaluation of pedagogical approaches to meet the evolving needs of a diverse student body. This article delves into these changes, with a particular emphasis on the adoption and impact of Hybrid Flexible (HyFlex) delivery models in higher education. Conducted at a Scottish university, this study focuses on a mandatory management accounting course for accounting and finance students, exploring how the HyFlex model aligns with principles of inclusivity and Universal Design for Learning.

The research examines student preferences for HyFlex education and its influence on academic performance, paying special attention to how these preferences and outcomes vary among students from different socio-economic backgrounds. The findings indicate that while a majority of students exhibit a preference for a blend of online and on-campus attendance, there is a notable inclination towards online engagement among students from more deprived areas. Factors such as travel challenges, work-life balance, and anxiety are identified as significant determinants in the choice of remote learning.

Additionally, the study reveals a moderate correlation between students' socio-economic status and their exam performance, with varying results across different modes of delivery. This suggests that while HyFlex education offers a flexible framework, its effectiveness and accessibility can differ based on individual student circumstances.

While further research is required for more definitive conclusions, this study contributes valuable insights into the post-pandemic educational landscape. It underscores the

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importance of adopting flexible and inclusive educational pathways, such as the HyFlex model, which not only adapt to technological advancements but also uphold principles of equity and student engagement, catering to the diverse needs of contemporary undergraduates.

Keywords
flexible study pathways, Universal Design for Learning, inclusivity in higher education, socio-economic background, online and blended learning, widening participation

Introduction
The COVID-19 pandemic has served as a catalyst for a paradigm shift in higher education, accelerating the adoption of online teaching technologies in universities beyond previous expectations (Rapanta et al., 2021). As the world transitions towards living with the coronavirus disease, with restrictions easing and universities resuming campus-based teaching activities, the role of technology in education has come to the forefront. This period has highlighted not only the necessity of embracing technology in pedagogy (Fogarty, 2020) but also the importance of developing teaching approaches that are inclusive and accessible to a diverse student population, in line with Peter Felten's principles. Felten emphasises the concept of ‘students as partners’, which advocates for collaboration between students and educators in the co-creation of learning experiences, fostering a sense of agency, equity, and mutual respect (Felten, 2013).

In this evolving educational context, the Hybrid Flexible (HyFlex) delivery model has emerged as a particularly compelling solution. HyFlex, a synchronous teaching approach that seamlessly integrates on-site and remote learning, offers students the flexibility to choose their mode of attendance (Abdelmalak & Parra, 2016). This approach is not only a response to logistical challenges but also a commitment to student-centred learning, aligning with Universal Design for Learning (UDL) principles (Kohler-Evans et al., 2019). It emphasises inclusivity and accessibility, accommodating different preferences, and external life commitments, thereby ensuring equitable access to education for all students.

Prior to the pandemic, research on student preferences for different delivery models highlighted a growing trend towards mobile and Web 2.0 technologies (Cassidy et al., 2014; Mann & Hennebery, 2012). The pandemic further shifted these preferences towards traditional synchronous teaching, particularly in courses requiring quantitative analysis (Sangster et al., 2020). Moreover, the choice of online courses often correlated with students’ external commitments, such as employment and family responsibilities (Fortin et al., 2019), underscoring the need for flexible and inclusive education models.

With universities and educators now experienced in online teaching, and students adapted to remote studying, this paper focuses on exploring the HyFlex model in depth. It examines student perspectives on HyFlex education and its impact on exam performance, particularly considering its alignment with inclusivity and accessibility principles.

Contribution
This research study provides a comprehensive exploration of student perspectives in the context of HyFlex education, the research sheds light on the unique challenges and benefits of HyFlex education for diverse student populations.

Building on the foundational principles of UDL, this study aims to contribute to the discourse on equitable education by examining how HyFlex education aligns with Peter Felten's principles of inclusivity and accessibility. Specifically, it addresses the research question: How do student preferences for HyFlex education impact academic performance, and to what extent do these preferences vary based on socio-economic backgrounds? This focus allows for a detailed examination of the specific challenges and benefits associated with HyFlex education, particularly for students facing socio-economic barriers or other constraints.

Previous research has demonstrated a growing preference for synchronous teaching methods in quantitative courses and increased use of mobile devices and Web 2.0 technologies in learning. This study extends these findings by evaluating the impact of HyFlex teaching on student learning outcomes, with a particular emphasis on how the model supports or hinders the participation of underrepresented and diverse student groups. While HyFlex teaching offers significant flexibility and accessibility – particularly for students managing external commitments or experiencing anxiety – it also presents challenges related to consistent engagement and academic performance. By examining these dual impacts, the study aims to inform more inclusive and effective educational practices. By exploring the dynamic learning requirements of contemporary undergraduates, including their varied experiences with and perceptions of HyFlex delivery, this study contributes to a deeper understanding of effective pedagogical approaches in the post-pandemic era. The findings will inform the design and implementation of flexible study pathways that prioritise inclusivity and accessibility, ensuring that educational practices not only adapt to technological advancements but also uphold the principles of equity and student engagement.

Historical evolution of distance learning to HyFlex education

Distance learning has undergone significant transformations since the 19th century, beginning with the University of London's pioneering correspondence courses that extended educational opportunities beyond traditional campus confines (Barclay, 2022; University of London, n.d.). The Open University's innovative use of television broadcasts in the 1960s further democratised education, leveraging emerging technologies to reach a broader audience (Barclay, 2022; Dorey, 2015). These early initiatives laid the groundwork for flexible education models that transcend geographical limitations.

The advent of digital technologies ushered in a new era of distance learning, leading to the development of blended learning models that integrate face-to-face instruction with online components (Dziuban et al., 2018; Garrison & Kanuka, 2004). Blended learning gained prominence as institutions sought to enhance student engagement and accommodate diverse learning preferences (Howell et al., 2003; Owston et al., 2013). The integration of asynchronous materials on Virtual Learning Environments with synchronous sessions via platforms like Zoom and Teams provided students with flexible participation options, effectively blending in-person and online learning to meet varied needs (Bligh et al., 2022; Kumar et al., 2021).

The COVID-19 pandemic accelerated this shift, necessitating a rapid transition to online platforms to maintain educational continuity (Bligh et al., 2022; Rapanta et al., 2021). This period highlighted not only the potential of technology-enhanced teaching but also the imperative of developing inclusive and adaptable learning environments (Fogarty, 2020; Govindarajan & Srivastava, 2020).

Building upon blended learning, the HyFlex model offers students the choice to attend classes in person or participate online synchronously, maximising flexibility and student agency (Abdelmalak & Parra, 2016). HyFlex education aligns with the principles of UDL, emphasising inclusivity and accessibility by accommodating different preferences, and external life commitments (Kohler-Evans et al., 2019; O'Ceallaigh et al., 2023).

Universal Design for Learning: A framework for inclusivity

UDL is an educational framework aimed at creating inclusive learning environments accessible to all students, regardless of their backgrounds or abilities (Basham et al., 2016). UDL is founded on three core principles:

- Multiple means of engagement: Motivating learners by providing choices in how they engage with the material;
- Multiple means of representation: Offering information in various formats to address diverse ways of perceiving and understanding content; and
- Multiple means of action and expression: Allowing students different ways to demonstrate their knowledge and skills.

In the context of blended and HyFlex learning, UDL principles are crucial for dismantling barriers to participation and fostering flexibility for diverse student needs (Casebolt & Humphrey, 2023; Hayward et al., 2020). The integration of digital tools facilitates varied representations of content and flexible engagement methods, catering to different learning preferences (Evans et al., 2010; Nguyen et al., 2021). The shift to online learning during the pandemic underscored the importance of designing courses that are inclusive and adaptable, highlighting UDL's role in mitigating learning barriers (Bearman et al., 2022).

Moreover, UDL emphasises student agency, empowering learners to make choices about their learning pathways – a critical consideration in addressing socio-economic and personal disparities in blended learning environments (Felten, 2013; Owiny et al., 2019). By providing flexible options, UDL aligns with the HyFlex model's goal of maximising accessibility and inclusivity.

Contributions of Kevin Kelly and Brian Beatty

Kevin Kelly's work on equitable online learning environments emphasises student engagement and inclusive teaching practices aligned with UDL principles (Nave, 2020). His advocacy for ‘transparency in learning and teaching’ provides educators with strategies to design clear and inclusive activities that effectively communicate objectives and assessment criteria, ensuring all students, regardless of background, can access and benefit from educational content (Kelly & Zakrajsek, 2023). Building on these principles, Brian Beatty's HyFlex model offers a practical framework for implementing blended learning that maximises student choice and flexibility (Beatty, 2014). By allowing students to select their mode of participation, the HyFlex model addresses diverse needs and preferences, including those with external commitments or socio-economic challenges (Abdelmalak & Parra, 2016; O'Ceallaigh et al., 2023). This approach directly aligns with UDL by offering multiple means of engagement and representation, further enhancing inclusivity and accessibility.

The HyFlex model is particularly significant in the post-pandemic context, where adaptable and student-centred learning options are crucial (Raes et al., 2020). It

empowers students to navigate their education around personal and external constraints, such as work commitments, caregiving responsibilities, and financial limitations (Holbrey, 2020).

Student engagement and outcomes in blended learning

Blended learning has been shown to enhance student engagement and academic outcomes by offering flexibility and catering to different learning preferences (Kobicheva et al., 2022; Owston et al., 2013; Vo et al., 2017). Studies indicate that blended learning environments can improve academic performance, satisfaction, and engagement when designed effectively (Ceylan & Kesici, 2017; Sahni, 2019).

However, challenges persist, particularly concerning socio-economic disparities and external commitments influencing students' mode of engagement (Gorard et al., 2006; Sosu et al., 2016). Students from lower socio-economic backgrounds often juggle employment and family responsibilities alongside their studies, impacting their ability to participate in traditional on-campus education (Greenbank, 2004; Kenyon, 2010). Travel issues, financial constraints, and caring commitments can hinder educational engagement, necessitating more flexible learning options (Field, 2022; Holbrey, 2020).

Anxiety and mental health concerns also influence preferences for online engagement, with some students finding remote learning environments more conducive to their well-being (Holbrey, 2020; Szopiński & Bachnik, 2022). The pandemic has exacerbated these issues, highlighting the need for educational models that support students' mental health and provide flexibility (Bearman et al., 2022; Bligh et al., 2022).

Blended and asynchronous education frequently incorporates various technologies, with Web 2.0 tools and smartphones playing a central role in modern students' learning experiences. Platforms such as YouTube and social media are widely used to access educational content and support academic studies (Holmes & Rasmussen, 2018; Hung & Yuen, 2010). These tools enable informal learning, helping students deepen their understanding and improve exam performance (Hrastinski & Aghaee, 2012; Jill et al., 2019; Tan, 2013).

Mann and Henneberry (2012) found a positive relationship between students' use of social networks and their choice of online courses. However, challenges such as the need for self-discipline, potential social isolation, and limited direct interaction with lecturers and peers are associated with online learning (Davis et al., 2019). Excessive screen time and reliance on technology raise concerns about potential impacts on academic performance and well-being (Davis et al., 2019).

HyFlex education offers a potential solution to the challenges faced by traditional blended learning by allowing students to engage remotely when necessary while still benefiting from on-campus participation when circumstances permit. While it retains the advantages of blended learning in enhancing student performance, there is limited research on its effectiveness for students from diverse socio-economic backgrounds. In particular, significant gaps remain in understanding:

- Influence on academic performance: How flexible participation options affect academic outcomes, particularly for students facing external pressures like employment or caregiving duties; and

- Socio-economic factors: The impact of socio-economic status on students' preferences for HyFlex education and their learning outcomes.

Existing studies often focus on the general effectiveness of blended learning without delving into how these models impact specific populations, especially those targeted by widening participation initiatives (Gorard et al., 2006; Sosu et al., 2016). There is a need for empirical research investigating the intersection of HyFlex education, UDL, and socio-economic factors to better support underrepresented or disadvantaged students.

Addressing these gaps is crucial for developing educational strategies that promote equity and inclusion. This study aims to:

- Examine student preferences: Investigate student preferences for HyFlex education and its influence on academic performance.
- Analyse socio-economic variations: Explore how preferences and outcomes vary among students from different socio-economic backgrounds.
- Identify influencing factors: Understand factors influencing students' choices of engagement modes, including employment, caregiving responsibilities, travel issues, finances, and anxiety.

By exploring these areas, the study seeks to provide insights into optimising HyFlex models to support diverse student populations and enhance educational equity. Understanding the specific needs and challenges of students from varying socio-economic backgrounds will inform the development of inclusive teaching practices aligned with UDL principles.

Methodology

Participants

The study was conducted within a second-year management accounting course at a Scottish university, selected to minimise potential adverse impacts on students' degree outcomes, as it is a non-honours course. Out of 163 students invited to participate, 99 responded to the survey, yielding a response rate of 60.7%. This cohort comprised students engaged in weekly HyFlex teaching sessions, excluding the first and sixth weeks. The study also aimed to investigate differences in preferences and attainment by analysing the top and bottom 25% of students based on engagement patterns, leaving out the middle 50% to enhance focus on contrasting behaviours.

Context of the study

The course ran over one semester, from September to November, comprising ten weekly sessions, of which eight were delivered in a HyFlex format. HyFlex teaching allowed students the flexibility to attend in person or participate online synchronously via Zoom. This approach aimed to accommodate diverse learning preferences while fostering inclusivity in line with UDL principles. The study setting emphasised replicating classroom experiences for all students, regardless of their chosen mode of engagement.

Instruments

Data collection relied on a comprehensive questionnaire informed by prior research (Beqiri et al., 2009; Xu & Jaggars, 2013). The survey captured information on:

- Students' usage of Web 2.0 technologies (e.g., YouTube and social media);

- Attendance patterns and reasons for mode selection;
- Demographic details, including SIMD (Scottish Index of Multiple Deprivation) profiles; and
- Exam performance outcomes.

Attendance data were triangulated through self-reports and lecturer headcounts, which consistently matched. No qualitative methods were employed in this study.

Data collection

Students were informed about the study's purpose and its voluntary nature during the course's introductory session, with assurances provided regarding anonymity and confidentiality. To minimise bias and encourage maximum participation, surveys were distributed online after the course had concluded. The subset analysis targeted two specific groups: students with minimal online attendance (defined as attending two or fewer online sessions) and those with high engagement (defined as attending seven or eight on-campus sessions), based on predetermined thresholds.

Data analysis

Quantitative analysis was conducted in Excel, employing correlation techniques to explore relationships between:

- Engagement methods (on-campus, online, and mixed);
- Deprivation levels, as measured by SIMD; and
- Exam performance.

The study aimed to identify patterns, focusing on differences in performance between students from varying socio-economic backgrounds and contrasting levels of engagement.

Findings

Student preferences for HyFlex learning

A total of 99 students participated in the survey, yielding a response rate of 60.7%. As shown in Table 1, the 99 students were further categorised based on the number of online sessions they attended.

Table 1. Students per engagement group

Predominately online	Mixed	Predominately on-campus
17	25	57

The small sample size limited the ability to draw definitive conclusions about which students were more likely to engage online, as seen in previous studies such as Holmes and Rasmussen (2018). Among the predominantly online group, 41% reported using YouTube for their studies, compared to 18% for the mixed group and 34% for the predominantly on-campus group. Consumption of current affairs through YouTube showed similarities across the three groups, with 47%, 35%, and 50% of respondents from the online, mixed, and on-campus groups, respectively, indicating its use. Additionally, a significant proportion of respondents from all groups (94% online, 90% mixed, and 89% on-campus) consumed news from social media platforms.

The increasing integration of smartphones into students' daily lives reflects a shift from traditional Web 2.0 learning tools to more mobile-centric engagement. While previous research has linked the use of social networks and video platforms to students' preferences for online learning (Holmes & Rasmussen, 2018; Mann & Hennebery, 2014), this study extends these insights by exploring smartphone usage patterns among students. The average daily screen time, measured using the built-in feature on Apple and Android smartphones, was 5 hours and 54 minutes overall. Online students had the highest average screen time at 6 hours and 28 minutes, followed by mixed students at 6 hours and 6 minutes, and on-campus students at 5 hours and 38 minutes. The number of pickups (i.e., instances where students checked their devices) throughout the day showed similar patterns, with online, mixed, and on-campus students reporting 111, 106, and 128 pickups, respectively. Calculating the average screen time per pickup revealed a correlation with the chosen mode of engagement. Online, mixed, and on-campus students averaged 3 minutes and 31 seconds, 3 minutes and 27 seconds, and 2 minutes and 38 seconds per pickup, respectively, representing a 32.9% increase in average screen time per pickup between on-campus and online students.

Engagement patterns across socio-economic backgrounds

Table 2 presents the attendance data for all ten weeks of the course. Examining the attendance data for the period excluding week 1 (due to the absence of the online option) and week 6 (due to mandatory online engagement), the average on-campus attendance was 62.4%, while online engagement averaged 32.6%. It is important to interpret these figures cautiously, as the respondents may predominantly represent regular attendees, and statistical adjustments cannot fully account for those who did not attend and did not respond.

Table 2. Self-reported mode of attendance

	W1	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**	**W9**	**W10**
Predominately online										
Online		64%	88%	100%	94%	100%	100%	100%	100%	82%
Campus	100%	36%	12%		6%					12%
Absent										
Mixed										
Online		29%	29%	24%	47%	100%	6%	12%	0%	59%
Campus	100%	71%	71%	76%	53%		65%	65%	78%	41%
Absent							29%	23%	23%	
Predominately on-campus										
Online		3%	5%	10%	8%	90%	13%	13%	19%	
Campus	97%	94%	93%	88%	92%		87%	85%	81%	93%
Absent	3%	3%	2%	2%	0%	10%	0%	2%	0%	

During the eight optional weeks, the data showed that a significant proportion of students engaged in online activities, with 71.7% participating online at least once. Remote attendance options were introduced in week 2, with 64% of this group engaging online initially. This figure rose to 100% by week 4 and remained above 80% for the rest of the course. The mixed group recorded its highest level of online engagement during week 5, but engagement declined in subsequent weeks, coinciding with a rise in significant absences from week 7 onwards. The predominantly on-campus group gradually increased their online engagement, peaking during week 9, the last normal teaching week. Notably,

50.7% of this group attended at least one online session, suggesting that the modest online attendance each week comprised different students. The data from week 6, when only online sessions were available and 10% of respondents were absent, suggests that this week may not have been fully inclusive for certain students. This absence, reported due to the lack of an on-campus session, highlights that not all students may find fully online weeks suitable, reinforcing the importance of flexible models that accommodate varied preferences and needs.

Filtering the data for Scottish postcodes resulted in 63 respondents. However, 12 students did not provide their parents' home postcode, making it impossible to apply the Scottish Index of Multiple Deprivation (SIMD) for these cases. Table 3 displays the distribution of respondents based on their parents' postcodes.

Table 3. Respondents by SIMD

Most (1, 2, 3)	**Middle (4, 5, 6, 7)**	**Least (8, 9, 10)**
11	11	29

Table 4 presents the students' self-reported attendance data categorised by their parents' postcode SIMD classifications. Among respondents from the three least deprived domiciles, there was a gradual increase in online engagement, culminating in one in three students attending online during weeks 4 and 7. In contrast, respondents from the three most deprived domiciles displayed the highest level of engagement in the online mode of delivery, attending online for seven out of the eight normal teaching weeks. Notably, over half of these respondents consistently attended online from week 4 onwards. The four remaining domiciles exhibited the second highest uptake in online engagement, eventually settling on an almost equal distribution between online and on-campus attendance.

Table 4. Self-reported mode of attendance by SIMD

	W1	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**	**W9**	**W10**
Least deprived										
Online		11%	18%	32%	25%	94%	33%	22%	29%	10%
Campus	100%	89%	79%	68%	75%		64%	72%	68%	84%
Absent			3%			6%	3%	6%	3%	6%
Middle										
Online		29%	36%	49%	49%	100%	49%	80%	56%	22%
Campus	93%	64%	64%	51%	51%		51%	20%	44%	71%
Absent	7%	7%								
Most deprived										
Online		37%	37%	63%	63%	100%	56%	67%	68%	58%
Campus	100%	63%	63%	37%	37%		34%	36%	32%	35%
Absent							10%			8%

Further exploration revealed that 100% of respondents from the bottom three SIMD deciles were employed throughout their studies, while only 36.3% from the top three deciles held employment during the majority of their studies. This significant contrast underscores the role that employment plays in the study choices of students from

different socio-economic backgrounds, highlighting the potential influence of external commitments on their engagement and mode of attendance.

Factors influencing students' choices of engagement modes

Table 5 provides a comprehensive overview of the reasons cited by respondents for attending on campus, while Table 6 delves deeper into these reasons based on the respondents' SIMD profile. The findings reveal intriguing insights, further highlighting the nuances within different domiciles.

Table 5. Reasons for attending remotely

Statement	**Strongly Agree or Agree**
Remote delivery helped with travel issues.	77%
Remote delivery helped with balancing work and study.	74%
Studying remotely helped with my anxiety.	66%
Remotely learning helped with my care/family commitments.	53%
Finances were a factor in choosing to study remotely.	37%
Remote delivery helped with a personal health issue (not including anxiety).	30%

Table 6. Reasons for attending remotely by SIMD

Statement	**Most**	**Middle**	**Least**
Remote delivery helped with travel issues.	91%	100%	71%
Remote delivery helped with balancing work and study.	91%	90%	28%
Studying remotely helped with my anxiety.	91%	30%	86%
Remotely learning helped with my care/family commitments.	82%	100%	14%
Finances were a factor in choosing to study remotely.	38%	30%	43%
Remote delivery helped with a personal health issue (not including anxiety).	62%	20%	43%

Among respondents from the three most deprived domiciles, the top three reasons for attending on campus align with the overall findings. Notably, respondents from the least deprived group emphasised finances as a prevailing factor, surpassing the other two groups.

For respondents residing in the middle four domiciles, care and/or family commitments emerged as a common driving factor for attending remotely, as reported by every respondent within this group. In contrast, respondents from the three least deprived domiciles provided a more diverse range of reasons for their attendance. Notably, the reasons reported by respondents from the least deprived domiciles differed from those reported by respondents from the remaining seven domiciles, particularly in relation to external commitments. The two reasons that scored the lowest were directly related to work and caring commitments.

Since the lecture delivery was technologically identical for both on-campus and remote students, additional questions were posed to on-campus students to explore their reasons for attending in person rather than remotely. Table 7 summarises the findings from these additional questions.

Table 7. The additional questions asked to the on-campus respondents, views of the mandatory online session

Statement	***better***	***same***	***worse***
Week 6 was ___ than I expected.	24%	58%	18%
Week 6 was ___ than the on-campus sessions.	3%	45%	53%
Week 6 was ___ than video recordings of the lecture.	39%	53%	8%
	more	***same***	***less***
I was ___ likely to attend a remote session after Week 6.	13%	61%	26%

Among the 13% of on-campus students who indicated a preference for attending online sessions, only 20% of this group followed through with online attendance.

Impact on academic performance

Table 8 displays the lowest, mean, and highest scores for each subset of students, while Table 9 presents the same grade distribution categorised by the students' parents' SIMD data. The university employs a 22-point scale GPA system, where a B3 and C1 equate to a low 60% and a high 50% score, respectively. In each group, the highest grade awarded in any of the groups was an A5, which corresponds to a low 70% score. The mean scores differ slightly, ranging from a low 60% to a high 50% across the groups. The most significant variation lies in the lowest score achieved, with the online, mixed, and on-campus groups scoring at approximately low 50%, low 40%, and high 30%, respectively.

Table 8. Exam performance per profile group

	Online	**Mixed**	**On-campus**
Lowest	C3	D3	E1
Mean	B3	C1	B3
Highest	A5	A5	A5

Table 9. Exam performance per SMID groups

	Most	**Middle**	**Least**
Lowest	D2	C3	D2
Mean	C2	B2	B3
Highest	B2	A5	A5

When exploring the relationship between the mode of engagement and exam performance, the findings reveal limited correlation. The online group exhibits a weak negative correlation ($r = -0.25$, $p < .001$), indicating that as online engagement increases, there is a slight decrease in exam performance. On the other hand, the on-campus group demonstrates a weak positive correlation ($r = 0.24$, $p < .001$), suggesting that higher levels of on-campus engagement are associated with slightly better exam performance. In contrast, the mixed group shows no significant correlation ($r = 0.07$, $p < .001$) between the mode of engagement and exam performance.

It is important to interpret these correlations with caution, as the magnitude of the correlations is relatively weak. While the negative correlation observed in the online group suggests a potential association between increased online engagement and slightly lower exam performance, it does not imply a causative relationship. Similarly, the positive

correlation in the on-campus group indicates a trend of slightly better exam performance with higher levels of on-campus engagement, but other factors may also contribute to this association.

The mean scores across the three groups differ slightly, ranging from a low 60% to a high 50%. Notably, the most significant variation lies in the lowest score achieved, with the online, mixed, and on-campus groups scoring at approximately low 50%, low 40%, and high 30%, respectively. These variations in scores highlight the importance of considering individual performance within each group and the potential impact of other factors beyond mode of engagement on exam outcomes.

Upon examining the relationship between the respondents' decile of deprivation and their exam performance, a moderate correlation becomes evident. The overall correlation coefficient for the entire sample is $r = 0.38$ ($p < .001$), indicating a meaningful association between deprivation and exam performance.

Specifically, within the online group, a moderate positive correlation ($r = 0.38$, $p < .001$) emerges, suggesting that higher levels of deprivation are associated with better exam performance among online students. In the mixed group, a weaker positive correlation ($r = 0.21$, $p < .001$) is observed, indicating a less pronounced relationship between deprivation and exam performance for this group. Conversely, the on-campus group exhibits a stronger positive correlation ($r = 0.42$, $p < .001$), suggesting a more substantial association between deprivation and exam performance among students attending on campus.

When coding the respondents' deprivation levels using the SIMD, further patterns are revealed. There is no significant correlation between the most deprived deciles and exam performance ($r = 0.12$, $p < .001$), indicating a lack of association between high deprivation levels and exam performance. In contrast, the middle deciles display a weak negative correlation ($r = -0.33$, $p < .001$), suggesting that moderate levels of deprivation are associated with slightly lower exam performance. Lastly, no significant correlation is found between the least deprived deciles and exam performance ($r = -0.06$, $p < .001$), indicating a lack of association between low deprivation levels and exam performance.

These findings shed light on the nuanced relationship between deprivation and exam performance, highlighting varying correlations across different groups and deciles. The moderate correlations in the online and on-campus groups suggest that deprivation may play a role in influencing exam outcomes, albeit to different extents. Meanwhile, the weaker correlations in the mixed group and among the specific deciles indicate a more complex interplay between deprivation and exam performance. These insights contribute to a deeper understanding of the impact of deprivation on academic achievement within the context of the study.

Academic performance across socio-economic backgrounds

Figure 1 illustrates the distribution of students by SIMD deciles and their corresponding academic performance. The chart highlights patterns in exam scores among students from different socio-economic backgrounds, focusing on disparities across the SIMD scale. It provides an overview of how academic outcomes vary for students from more deprived areas compared to those from less deprived areas.

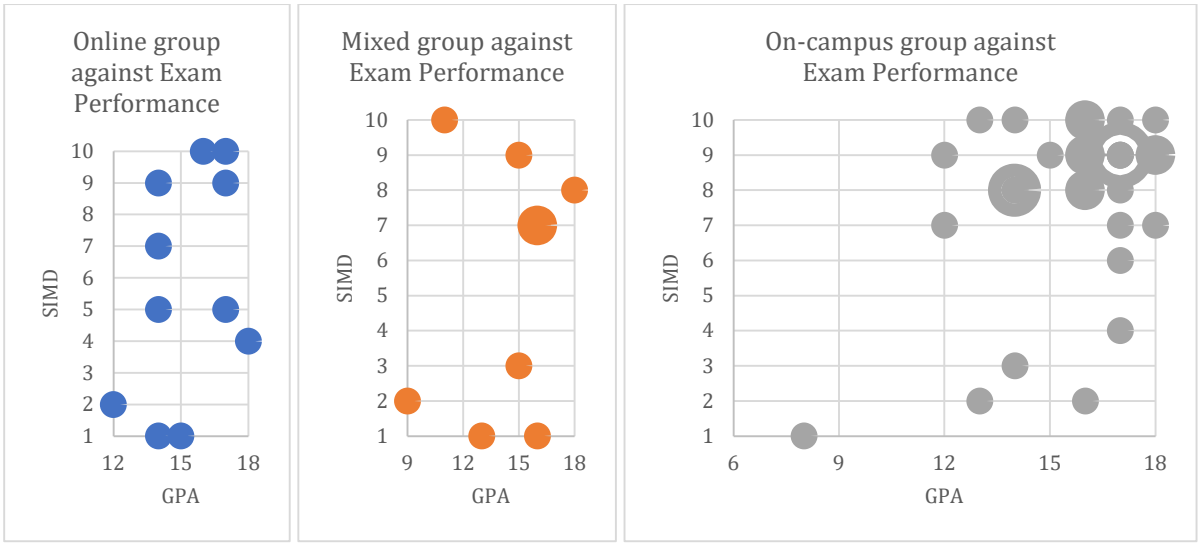

Figure 1. Delivery mode against exam performance

Table 10 presents a comparative analysis of exam performance across engagement modes (online, on-campus, and mixed) for students in the three most deprived SIMD deciles. The table outlines the mean, lowest, and highest scores for each group, offering insights into the relationship between engagement mode and performance.

Table 10. Exam performance of the three lowest deciles per their respective study groups

	On-campus	**Mixed**	**Online**
Lowest	E1	D3	C3
Mean	C2	C2	C1
Highest	B2	B2	B3

Discussion

Table 1 provides valuable insights into student preferences for different modes of delivery, highlighting that only a minority of students prefer a fully online approach. The majority of students, encompassing 70.7% of the sample, engage in some form of mixed delivery, indicating a preference for a flexible and fluid approach to their studies. Specifically, 6.0% of students prefer fully online engagement, while 28.3% opt for on-campus attendance. These findings resonate with previous studies, which have also indicated a preference for blended learning among students (Pontes et al., 2010; Skopek & Schuhmann, 2008). It is noteworthy that these preferences are consistent across undergraduate and postgraduate students, suggesting that both groups face similar challenges and exhibit similar preferences in their learning journey (Pontes et al., 2010; Skopek & Schuhmann, 2008).

Examining the reasons for attending remotely, as depicted in Table 6, reveals interesting variations based on the respondents' parents' postcodes, coded by the SIMD. Students from the most deprived areas prioritise travel, anxiety, and balancing work and study as significant factors influencing their choice of online attendance (Gorard et al, 2006; Greenbank, 2004; Holbrey, 2020; Kenyon, 2010; Sosu et al, 2016). In the middle deciles, caring commitments emerge as a more prominent reason compared to anxiety. In contrast, respondents from the least deprived areas highlight travel issues and report higher levels of anxiety compared to caring commitments or balancing work and study.

These findings emphasise the multifaceted nature of student preferences and the influence of contextual factors on their mode of engagement. It is important to acknowledge that this study did not collect information on students' accommodation status, which could have provided additional insights into the impact of housing availability on their preferences.

Table 4 introduces the coding of SIMD into the self-reported attendance data, shedding light on the relationship between deprivation and mode of engagement. Notably, respondents from the bottom three deciles, indicating higher levels of deprivation, demonstrate the highest utilisation of the online mode. A simple analysis reveals that students from the bottom three deciles utilise the online mode twice as much as those from the top three deciles. The findings that all respondents from the bottom three SIMD deciles were employed throughout their studies, contrasted with only 36.3% from the top three deciles, indicate the significant role of employment as a factor influencing engagement. This aligns with the broader understanding that students' external commitments, particularly among those from more deprived backgrounds, can shape their study preferences and necessitate more flexible learning options. These findings align with previous research (Gorard et al., 2006; Greenbank, 2004; Holbrey, 2020; Kenyon, 2010; Sosu et al., 2016), underscoring the persisting disparity in employment rates among students from different socio-economic backgrounds. It is noteworthy that the top reason for attending online, as indicated in Table 5, was to help balance work and study commitments, further emphasising the impact of employment on undergraduate students' mode of engagement.

Past studies (Gorard et al., 2006; Sosu et al., 2016) have highlighted the negative impact of employment on exam performance, particularly among students from deprived backgrounds. In line with this, this study identifies a moderate correlation between the respondents' parents' postcodes, coded by SIMD, and exam performance. Focusing on the lowest three deciles, as shown in Table 9, it becomes evident that this subgroup had the lowest grades across the lowest, mean, and highest awarded grades. Intriguingly, despite all respondents in the lowest three deciles reporting engagement in work throughout their studies, no significant correlation is found within this subgroup. These findings indicate the complex interplay between deprivation, employment, and exam performance, highlighting the need for further investigation to better understand the underlying mechanisms at play.

Figure 1 provides a comprehensive breakdown of the composition of the three groups based on the SIMD categories, offering insights into the distribution of students across different SIMD deciles. The analysis reveals distinct patterns in the distribution of students from various deciles within each group. The on-campus group exhibits a higher concentration of students with parent postcodes coded in the top three deciles, comprising 71.0% of the group. In contrast, the online and mixed groups have 36.4% and 33.3% of students from the top three deciles, respectively.

However, when considering the grade distribution, interesting disparities become apparent. Despite the higher concentration of students from the top three deciles in the on-campus group, the dominance in higher grades is not as pronounced. The online and mixed groups demonstrate 54.5% and 66.7% of grades at GPA point 15 or higher, respectively, showcasing a strong performance among these groups. Surprisingly, the mixed group exhibits the highest concentration of students with parent postcodes from

the lowest three deciles, accounting for 44.4% of the group. In contrast, the online and on-campus groups comprise 27.2% and 9.7% of students from the lowest three deciles, respectively. These findings suggest that while the on-campus group has a higher proportion of students from higher deciles of deprivation, the mixed group encompasses a significant number of students from more deprived backgrounds and achieves notable academic success.

The results from Figure 1 emphasise the complex relationship between deprivation, mode of engagement, and academic performance. While the on-campus group may have a higher representation of students from higher deciles of deprivation, this does not necessarily translate to better grades. The online and mixed groups, with a mix of students from various deprivation deciles, demonstrate commendable performance, particularly the mixed group with its significant proportion of students from the lowest deciles. These findings challenge preconceived notions about the relationship between deprivation, mode of engagement, and academic outcomes, emphasising the need for a nuanced understanding of these dynamics.

The analysis presented in Figure 1 provides valuable insights into the distribution of students across SIMD deciles within each group and their corresponding grade performance. The findings highlight the diverse nature of student backgrounds and the nuanced relationship between deprivation, mode of engagement, and academic achievement. Further investigation is warranted to explore the underlying factors contributing to the success of students from more deprived backgrounds within the mixed group, as well as to uncover potential support mechanisms that can aid students in overcoming socio-economic barriers to education.

When examining the impact of flexible study pathways on students targeted by the widening participation agenda, it is essential to consider the evidence provided by JISC (2023). By focusing on the three lowest SIMD deciles and using the on-campus group as the control, which closely represents the traditional in-person teaching experience, the findings suggest limited support for the notion that a mixed pathway leads to improved exam performance. The performance of the mixed group was comparable to the mean and highest grades, indicating that students following a mixed pathway achieved similar outcomes to those in the on-campus group. Notably, the mixed group showed improvement in the lowest grade awarded.

Surprisingly, the online group surpassed the on-campus group in terms of the lowest and mean grades, suggesting that online engagement may have some advantages for students targeted by the widening participation agenda. However, it is important to interpret these statistics with caution due to the small sample size utilised in this study. Further research with a larger sample size is necessary to draw more conclusive insights and validate these findings.

These findings contribute to the ongoing discussion on the effectiveness of flexible study pathways for widening participation students. While the mixed pathway did not demonstrate significant improvements in exam performance compared to the on-campus group, the online group exhibited promising outcomes in terms of the lowest and mean grades. These findings suggest that online engagement may offer certain benefits for students from more deprived backgrounds. However, the limitations of the current study highlight the need for additional research to confirm these observations and provide a

more comprehensive understanding of the relationship between flexible study pathways, widening participation, and exam performance.

Conclusion

This study provides valuable insights into the potential of the HyFlex model to address diverse student needs in higher education, with a specific focus on socio-economic diversity and academic performance. By analysing attendance patterns, preferences, and outcomes across socio-economic backgrounds, the research demonstrates that students from the three most deprived SIMD deciles engaged more frequently in online learning, attending online sessions in seven out of eight normal teaching weeks. Over half of these students consistently chose online participation from week 4 onwards, highlighting the role of flexibility in mitigating barriers such as travel costs, work-life balance, and other constraints.

However, the analysis also revealed disparities in academic performance. Students in the lowest SIMD categories who engaged primarily online achieved slightly higher mean scores than their on-campus counterparts but exhibited the largest range in performance, with some students achieving significantly lower grades. These findings underscore the importance of understanding how socio-economic factors influence both engagement and learning outcomes, emphasising the need for targeted interventions to support equity in education.

Practical implications

The findings offer several actionable recommendations for educators and institutions:

- Empowering student choice: Institutions should implement tools and resources to help students make informed decisions about their mode of engagement, tailored to individual circumstances such as work or caregiving responsibilities.
- Addressing socio-economic barriers: Universities must provide targeted support for students from disadvantaged backgrounds, such as improving access to reliable technology and offering hybrid-friendly academic resources.
- Balancing flexibility with academic rigour: Educators should consider developing pedagogical strategies that maintain consistent engagement and support students across all modes of participation, particularly online.

Directions for future research to further enhance understanding of HyFlex education, future studies could:

1. Investigate long-term academic and career outcomes associated with HyFlex participation.
2. Examine how discipline-specific factors influence the effectiveness of HyFlex delivery models.
3. Explore the role of digital literacy and access to technology in shaping engagement and outcomes.
4. Assess how institutional policies can mitigate performance gaps among socio-economically disadvantaged students.

By grounding these implications and future directions in the findings of this study, this research provides a solid foundation for advancing inclusive and adaptable teaching practices. The results highlight the need for continued innovation in higher education to

ensure that all students, regardless of background, can thrive in a flexible and equitable learning environment.

Disclosure statement

The authors report there are no competing interests to declare.

Data availability statement

The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research supporting data is not available.

Ethical statement

This study was conducted in accordance with the ethical guidelines and standards set forth by identifiable information. All necessary ethical requirements, including informed consent, privacy protection, and data anonymisation, were rigorously adhered to throughout the research process. The study obtained appropriate ethical approval from the identifiable information, ensuring the rights, dignity, and confidentiality of the participants. The data collected for this study were handled with utmost care and in compliance with applicable data protection regulations. Participants' identities have been anonymised, and all personal information has been kept strictly confidential. The findings presented in this article are based on fully ethical procedures, and all ethical requirements have been duly met.

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