Digital transformation in higher education: tertiary students' perspectives on online learning and its implications for the future

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Abstract: This study investigated 400 Hong Kong tertiary students' experiences during a rapid transition to online learning. Through quantitative surveys, researchers examined technology access, teacher digital competency, learning environments, privacy concerns, and perceived teaching effectiveness. While most students had the necessary devices, poor internet connectivity and disruptive home environments posed challenges, especially for lower-income students. Teachers' digital skills were generally rated positively, though areas for instructional improvement were identified. Students appreciated online learning flexibility but struggled with concentration and missed face-to-face interaction. Privacy concerns regarding webcams and online security were prominent. Income levels correlated negatively with resource adequacy and environmental disruptions. The findings suggest implementing an agile-blended learning approach that combines online flexibility with in-person instruction while addressing digital equity, teacher training, and student privacy needs. The research emphasises the importance of continuous adaptation to meet evolving student needs and technological advancements in higher education.

Keywords: online learning; higher education; digital equity; student experience; agile-blended learning.

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1   Introduction

The rapid shift to online learning in recent years has marked a watershed moment in the history of education. While educational institutions have been gradually integrating technology into their teaching practices, the unprecedented scale and speed of digital transformation presented unique challenges and opportunities. The swift transition from traditional face-to-face instruction to virtual classrooms highlighted both the potential and limitations of online learning. This period of rapid change, often characterised as emergency remote teaching (ERT) (Hodges et al., 2020), differed significantly from purposefully designed online learning environments. The initial adaptation phase frequently involved modifying existing materials and pedagogical approaches to an online format with limited time for preparation and training, often resulting in suboptimal learning experiences (Bozkurt and Sharma, 2020). However, this transformative period also served as a catalyst for innovation and accelerated the adoption of digital technologies in education, prompting a critical examination of the role of technology in teaching and learning.

The experience of Hong Kong's tertiary institutions during this digital transformation offers a valuable case study for understanding the challenges and opportunities associated with the rapid transition to online learning (Lam and Ng, 2023). When universities in Hong Kong implemented large-scale online instruction, this shift impacted thousands of students, raising important questions about access to technology, the effectiveness of online instruction, and the overall student experience (Li et al., 2023; Wong and Tang, 2021). This study examines the experiences of tertiary students in Hong Kong during this period of intensive online learning implementation. Specifically, it investigates student access to necessary technology and resources, their perceptions of their teachers' digital capabilities, the characteristics of their learning environments, their concerns regarding privacy in online settings, and their views on the effectiveness of online learning and teaching.

This research contributes to the growing body of literature on online learning in higher education by providing insights into student experiences during a period of rapid and widespread digital adoption. Furthermore, it explores the issue of digital equity, examining whether family income played a role in students' satisfaction with their learning progress. By examining these experiences, this study aims to inform the development of more effective and equitable online and blended learning strategies for the future of higher education.

1.1 Online learning in higher education

The integration of technology into higher education has been an ongoing process for decades, with online learning gaining increasing prominence. Online learning has become a viable alternative to traditional face-to-face instruction, offering flexibility and accessibility to diverse student populations. Research consistently demonstrates that well-designed online courses can be as effective as, or even more effective than, traditional courses in promoting student learning outcomes (Means et al., 2010). However, the effectiveness of online learning is contingent upon various factors, including course design, pedagogical approaches, student engagement, and institutional support (Bates, 2019).

One key aspect of effective online learning is the creation of engaging and interactive learning experiences. This can be achieved through the use of multimedia resources, collaborative activities, and opportunities for student interaction (Wong et al., 2024). Furthermore, effective online instructors need to possess strong digital literacy skills and be adept at using technology to facilitate learning and communication (Laurillard, 2012). The quality of online course design and the pedagogical approaches employed are crucial in fostering student engagement and promoting successful learning outcomes.

Another important consideration in online learning is the role of student self-regulation and motivation. Online learners need to be self-directed and motivated to engage with the course material and participate in online activities (Means et al., 2013). This requires effective time management skills, the ability to work independently, and a willingness to participate actively in online discussions and collaborative projects. Institutions can support student success in online learning by providing resources and training on self-regulated learning strategies.

1.2 Digital equity and the homework gap

The transition to online learning has also brought the issue of digital equity to the forefront. The 'homework gap', referring to the disparity in access to technology and reliable internet connectivity among students from different socioeconomic backgrounds (Reisdorf et al., 2019; Crocker and Kleitsch, 2023), remains a significant concern in contemporary education. Students from low-income families often lack access to the necessary devices, internet connectivity, and supportive learning environments for successful online learning (Gomez-Caride, 2023). This disparity can exacerbate existing educational inequalities and create further disadvantages for students from marginalised communities. Research has shown that limited access to technology and internet connectivity can negatively impact student academic performance and contribute to the achievement gap (Warschauer, 2003).

Furthermore, digital equity encompasses more than access to devices and internet connectivity. It also includes access to digital literacy skills and the ability to use technology for learning effectively (Eshet-Alkalai, 2004). Students who lack these skills may struggle to navigate online learning platforms, access online resources, and participate fully in online learning activities. Addressing the digital divide requires a multi-faceted approach that includes providing access to technology and internet connectivity, as well as developing digital literacy skills among students and educators. This is particularly crucial in contexts like Hong Kong, where socioeconomic disparities can influence access to educational resources.

1.3   The digital transformation of higher education

The rapid digital transformation of higher education has significantly accelerated the adoption of online learning and highlighted the need for robust digital infrastructure and effective online pedagogical practices. This shift has exposed pre-existing inequalities in access to technology and digital literacy skills, further emphasising the importance of addressing the digital divide (Daniel, 2020). The transformation has also underscored the need for flexible and adaptable learning environments that can cater to diverse student needs and circumstances. As a result, there has been a growing interest in hybrid and blended learning models that combine the benefits of both online and face-to-face instruction (Horn and Staker, 2014).

The role of technology in higher education continues to evolve, with new tools and platforms emerging to support online and blended learning. Learning management systems (LMS), video conferencing platforms, and interactive learning technologies have become increasingly sophisticated, offering new possibilities for engaging students and enhancing learning outcomes (Bates, 2019). Furthermore, recent years have spurred the development of innovative approaches to online assessment, including the use of online proctoring tools and alternative assessment methods (Hartnett et al., 2023). These advancements in educational technology can potentially transform higher education and create more flexible, personalised, and accessible learning experiences for students.

However, it is crucial to ensure that these technologies are used effectively and ethically, with a focus on promoting equity and inclusion. This research aims to contribute to this ongoing discussion by examining the experiences of tertiary students in Hong Kong during the initial phase of the pandemic-driven shift to online learning, providing valuable insights for shaping the future of higher education. Specifically, it was guided by the following research questions:

1   What were the experiences of tertiary students in Hong Kong with online learning, specifically regarding:

   a   Access to and availability of necessary facilities and equipment?

   b   Perceptions of their teachers' digital capabilities?

   c   The characteristics of their learning environment?

   d   Concerns regarding privacy in online learning settings?

   e   Perceptions of the effectiveness of online learning and teaching?

2   What were the perceived advantages and disadvantages of online learning from the students' perspective?

3   Did family income influence students' experiences and perceptions of the advantages, disadvantages, or potential improvements of online learning?

2   Methodology

This study employed a quantitative research design using an online questionnaire to collect data from tertiary students in Hong Kong during a period of widespread online learning implementation. This method was chosen for its ability to efficiently gather data from a large sample population and facilitate statistical analysis.

2.1 Participants

A total of 400 tertiary students from 20 institutions across Hong Kong participated in this study. The participants' ages ranged from 17 to 60 ($M = 22.16$, $SD = 3.91$). The majority were undergraduate students (97.3%), with most in year 3 (28.2%) or year 4 (34.4%). Year 1 (12.9%) and year 2 (10.6%) undergraduates, along with postgraduate students (2.7%), constituted the remaining participants. Participants reported spending an average of 15.0 hours per week ($SD = 8.00$) engaged in online learning. Regarding family income, the most frequently reported monthly brackets were HK\$15,001 to HK\$30,000 (34.9%) and HK\$30,001 to HK\$50,000 (19.8%)[1]. While the sample aimed to capture the diversity of the tertiary student population in Hong Kong, systematic collection of demographic information beyond the above variables was not conducted (see Table 1 for a detailed breakdown of participant demographics).

Table 1 Participants' age, monthly family income, and hours spend weekly on online learning

Item	n	Percentage (%)
Age (n = 356)		
<=20	90	25.3
21–23	215	60.4
>23	51	14.3
Monthly family income (n = 351)		
Below HK\$15,000	77	21.9
HK\$15,001–30,000	141	40.2
HK\$30,001–50,000	80	22.8
HK\$50,001–70,000	33	9.4
HK\$70,001–100,000	10	2.8
Above HK\$100,000	10	2.8
Hours spent online learning weekly (n = 337)		
<=10.00	91	27.0
10.01–15.00	91	27.0
15.01–17.00	75	22.3
>17.01	80	23.7

Participants were recruited through their lecturers at their respective institutions. These lecturers were either acquaintances of the authors or acquaintances of their acquaintances. This convenience sampling method, whilst efficient, may have introduced selection bias, limiting the generalisability of the findings to the broader tertiary student population in Hong Kong. Furthermore, the online nature of the questionnaire may have inadvertently introduced additional selection bias, as participation required internet access and a certain level of digital literacy. This potential bias should be considered when interpreting the results.

2.2   Procedure

The lecturers distributed the questionnaire link to their students either in class or through email. The questionnaire was hosted on Qualtrics, an online survey platform. The first page of the questionnaire provided information regarding the research, including its purpose, the voluntary nature of participation, and the assurance of anonymity. Participants were required to click an 'I understand the above and wish to start the questionnaire' button before proceeding to the questions. No personally identifiable information, such as student names, was collected. The estimated completion time for the questionnaire was approximately 10 minutes.

2.3   Instrument

The questionnaire designed specifically for this study aimed to collect comprehensive data on students' perspectives regarding online learning. It comprised five sections, each addressing a key aspect of the online learning experience:

1   Available facilities/equipment: this section assessed students' perceptions of the adequacy of resources and support for online learning. This section examined access to devices, internet connectivity, and institutional support. Sample questions included whether students felt they had adequate access to necessary devices and if they believed institutional support was sufficient. This construct is crucial for understanding how resource availability impacts the online learning experience.

2   Teachers' digital capability: this section evaluated students' perceptions of their teachers' skills and comfort levels with digital technologies. Questions focused on teachers' proficiency with online tools and their effectiveness in adapting teaching methods to the online environment. For instance, students were asked if they felt their teachers effectively used online instruction tools. Understanding teachers' capabilities is vital, as it directly influences student engagement and learning outcomes.

3   Learning environment: this section investigated the characteristics of students' learning environments during online learning. This included factors such as distractions and the overall learning atmosphere. Sample questions explored whether students experienced many distractions while studying online and whether they found the atmosphere supportive. A conducive learning environment is essential for maintaining student focus and productivity.

4   Concerns for privacy: this section explored students' apprehensions regarding privacy and data security in online learning settings. Questions examined issues related to the use of webcams and the security of online platforms. For example, students were asked if they were concerned about sharing their surroundings during online classes. Addressing these privacy concerns is vital for fostering a safe online learning environment.

5   Views of learning and teaching effectiveness: this section examined students' perceptions of the overall quality of online instruction. It included questions about satisfaction with their learning progress, motivation and engagement. Sample questions solicited students' opinions on whether they were satisfied with their

learning progress and felt online instruction met their educational needs. Evaluating student satisfaction provides valuable insights into the effectiveness of online education.

Most questionnaire items employed a 5-point Likert-type response scale ranging from 1 (strongly disagree) to 5 (strongly agree), but some multiple choice and rating questions were also used. Following these close-ended items, participants responded to two open-ended questions: one asking about the advantages and disadvantages of online learning and the other soliciting suggestions for improvement. Basic demographic information was also collected.

2.4 Data analysis

Descriptive statistical analyses were performed using IBM SPSS version 28. Different descriptive statistics were employed for the closed-ended items based on the response format. Mean scores and standard deviations were calculated for 5-point Likert-type items to identify overall trends in student perceptions and experiences with online learning. Percentages were computed for multiple-choice items to describe the distribution of responses across different categories. Two-tailed Pearson's correlations were calculated between family income and all Likert-type items to explore their relationships.

Open-ended questions were analysed using thematic analysis. Responses were reviewed iteratively to identify recurring themes and patterns related to the advantages and disadvantages of online learning, as well as student suggestions for improvement. The prevalence of each identified theme was then quantified by calculating the percentage of responses in which each theme occurred.

3 Results

3.1 Available facilities/equipment

Student responses regarding available facilities and equipment for online learning revealed concerns about adequacy and equity. Most students owned laptops (89.1%) and smartphones (88.0%), suggesting adequate access to devices for online learning. However, access to stable network connections and quiet study spaces emerged as key concerns. Students ranked stable network connections and silent surroundings as the most essential requirements for online learning (Ms = 1.43 and 2.05, respectively, where 1 represents 'most essential'). This was further corroborated by the high percentage of students (75.5%) reporting unstable network connections as a frequently encountered technical difficulty. Other common technical issues included difficulties entering meeting rooms (44.6%) and audio/video malfunctions (35.6%). While students tended to disagree that online learning increased their financial burden ($M = 2.49$), a notable portion still felt this way. Furthermore, students moderately agreed that those with better financial backgrounds were more advantaged in online learning ($M = 3.51$), highlighting potential equity concerns. The relatively low mean scores related to the adequacy of personal and institutional support (Ms = 2.55 and 3.30, respectively) suggest that many students felt their online learning facilities lagged behind others and that institutions could provide

more support. The finding that students slightly disagreed with the statement 'Lack of online learning facilities hinders my learning' (M = 2.98) presents a somewhat contradictory picture, perhaps indicating that while students recognised limitations in facilities, they did not necessarily see these limitations as major impediments to their learning.

3.2   Teachers' digital capability

Student perceptions of their teachers' digital capabilities were generally positive but revealed areas for growth. While mean scores on a 5-point Likert scale ranged from 2.82 to 3.59, indicating agreement leaning towards neutrality rather than strong endorsement, several important observations emerged. A mean score of 2.82 for the clarity of online teaching compared to traditional modes indicates a notable area of concern. This suggests that teachers struggled to translate the clarity of in-person instruction to the online environment. Moreover, while students generally agreed their teachers could use online learning tools for interaction, guidance, and teaching, the clustering of mean scores around the midpoint (3.0) suggests this agreement was more neutral than enthusiastic. Scores for consistently and effectively using diverse online materials (Ms = 3.41 and 3.43) and teachers' experience and training in preparing online materials (M = 3.12) further underscore the need for development in these areas.

3.3   Learning environment

Students reported mixed experiences with the online learning environment. While they found online learning more relaxing (M = 3.38), they also noted frequent disruptions from their surroundings (M = 3.58) and background noise (M = 3.31). The lack of face-to-face interaction also presented a challenge, making it harder for some to concentrate (M = 3.02). Furthermore, students did not perceive online learning as conducive to increased interaction with teachers, as evidenced by lower scores for answering (M = 2.76) or asking (M = 2.86) questions. Similarly, they did not find it particularly beneficial for peer collaboration (M = 2.35).

3.4   Concerns for privacy

Student responses revealed significant concerns about privacy in online learning environments. Students strongly disagreed with willingly turning their cameras on during online learning (M = 1.80), indicating a strong aversion to being visibly present. However, they moderately agreed that they were conscious of their background when their camera was on (M = 3.73), suggesting an awareness of privacy implications even when choosing to activate their camera. Furthermore, students strongly agreed that video conferencing applications posed a risk of being hacked (M = 4.03), highlighting a pervasive concern about online security.

3.5   Views of learning and teaching effectiveness

Student opinions on the effectiveness of online learning and teaching were generally mixed. While students moderately agreed that online learning provided greater freedom and flexibility in managing their learning schedule and pace (Ms = 3.40 and 3.39,

respectively), they were less optimistic about its impact on motivation, self-learning, and evaluation of their learning process (*M*s = 2.74, 3.23 and 3.04, respectively). Interestingly, despite these mixed views, students generally felt that online learning could not fully replace traditional in-person learning. On a scale of 0 (completely not) to 10 (completely can), the average rating was 4.66, indicating a leaning towards the belief that online learning, while valuable, cannot entirely substitute for the benefits of face-to-face instruction.

Table 2 shows the results of the 5-point Likert-type items.

Table 2   Results of 5-point Likert-type items

Item	M	SD	r with family income	p-value
Available facilities/equipment (n = 375)				
The lack of online learning facilities hinders my learning.	2.98	1.08	−.177***	<.001
Online learning increases my financial burden.	2.49	1.02	−.179***	<.001
Students with good finances are more advantaged in online learning.	3.51	0.96	−.088	.101
My online learning facilities lag behind others'.	2.55	1.00	−.202***	<.001
My institution does not provide enough facilities/equipment for online learning.	3.30	0.91	−.141**	.008
Teachers' digital capability (n = 369)				
My teachers can use online learning tools to provide sufficient interaction.	3.48	0.84	−.052	.327
My teachers can clearly guide me on how to use online learning tools.	3.48	0.86	−.053	.320
My teachers can provide timely guidance and assistance to help me solve problems through online learning tools.	3.59	0.80	−.039	.462
My teachers can use online learning tools for teaching.	3.59	0.79	−.068	.205
My teachers can frequently use various electronic learning resources.	3.43	0.90	−.033	.533
My teachers can effectively use various electronic learning resources.	3.41	0.85	−.077	.151
My teachers' online teaching is clearer than traditional teaching.	2.82	1.03	.002	.967
My teachers have sufficient experience and training to prepare online teaching materials.	3.12	0.89	.001	.985

Note: *p < .05, **p < .01, ***p < .001.

Table 2   Results of 5-point Likert-type items (continued)

Item	M	SD	r with family income	p-value
Learning environment (n = 365)				
My surroundings frequently disrupt my online learning.	3.58	1.00	–.165**	.002
Teacher/student background noise frequently disrupts my online learning.	3.31	1.00	–.089	.096
Not seeing the teacher in person makes it difficult to concentrate in online classes.	3.02	1.11	–.049	.361
Online learning is more relaxing than traditional learning.	3.38	1.04	.047	.382
Online learning makes me more eager to answer teachers' questions.	2.76	1.08	.013	.807
Online learning makes me more eager to ask teachers questions.	2.86	1.08	–.003	.960
Online learning offers more opportunities for peer collaboration.	2.35	0.96	.050	.349
Concerns for privacy (n = 365)				
I willingly turn on my camera during online learning.	1.80	0.90	.056	.297
I am conscious of my background during online learning when my camera is on.	3.73	1.09	–.028	.603
Video conferencing apps risk being hacked.	4.03	0.90	–.064	.230
Views of learning and teaching effectiveness (n = 365)				
Online learning increases my motivation.	2.74	0.95	.038	.481
Online learning gives me more freedom over my learning schedule.	3.40	1.10	.007	.889
Online learning gives me more flexibility to learn at my own pace.	3.39	1.07	.009	.867
Online learning has improved my self-learning ability.	3.23	1.07	.056	.295
Online learning helps me evaluate my learning process and results.	3.04	1.00	–.014	.795

Note: $*p < .05$, $**p < .01$, $***p < .001$.

3.6   Advantages, disadvantages and areas for improvement

Students identified a range of advantages and disadvantages associated with online learning (Table 3). The most frequently cited advantage was reduced travel time and expense (37.8%), followed by the ability to learn at their own pace (30.4%). Convenience (12.7%) and the option to rewatch lectures/videos (8.1%) were also highlighted as key benefits. These findings suggest that online learning offers significant flexibility and accessibility, which students highly value.

Conversely, the most prominent disadvantage was technical issues (26.1%), encompassing internet connectivity problems and hardware malfunctions. This highlights the critical role of reliable technology in ensuring a positive online learning experience. The lack of face-to-face interaction (20.4%) and the difficulty concentrating in a home environment (22.4%) were also frequently mentioned challenges. These findings underscore the social and environmental aspects of learning, which the shift to online modalities can negatively impact.

Table 3   Advantages and disadvantages of online learning identified by participants (n = 260)

Themes	*Definition*	*Percentage (%)*
Advantages (n = 260)		
Reduced travel time and expense	Saved time and money on commuting	37.8
Self-paced learning	Control over learning speed (pause, rewind, etc.)	30.4
Convenience	Easy access; can study anywhere	12.7
Rewatching lectures/videos	Review recorded sessions for notes and clarity	8.1
Increased teacher interaction	More opportunities to interact with teachers online	4.2
More relaxed environment	Less stressful learning setting	3.8
Others	Any other advantages identified	3
Disadvantages (n = 241)		
Technical issues	Internet connectivity problems, hardware malfunctions	26.1
Lack of face-to-face interaction	Difficulty connecting with teachers and peers; missing campus life	20.4
Difficulty concentrating	Distracting home environment, challenges focusing outside of a classroom setting	22.4
Motivation/self-control required	Need for strong self-discipline and motivation to succeed online	8.7
Lack of immediate support	Delays in getting help or feedback	7.1
Online privacy concerns	Worries about data privacy and security in online platforms	5.8
Teacher tech issues	Teachers' struggles with online tools or platforms	5.0
Others	Any other disadvantages identified	4.5

When asked about potential improvements, resolving technical issues (21.9%) was the most frequent suggestion, reinforcing the importance of addressing technological barriers. Students also emphasised the need for safer online platforms (17.5%) and better teacher training on using online tools (16.4%). Providing pre-recorded lectures (14.2%) and increasing interactive activities (11.5%) were also popular suggestions, reflecting the desire for both flexibility and engagement in online learning.

Table 4   Suggested improvements for online learning (n = 183)

Areas of improvements	Definition	Percentage (%)
Resolve technical issues	Fix internet connectivity, lagging, and software problems	21.9
Safer online platforms	Use more secure platforms or enhance security measures	17.5
Teacher training (online tools)	Provide training on using online teaching platforms effectively	16.4
Pre-recorded lectures	Record lectures for students to review at their convenience	14.2
Increased interaction	More interactive activities and use of online tools (polls, annotations, etc.)	11.5
Flexible timetabling	Offer more flexible schedules for accessing learning materials	7.2
Controllable environment	Reduce distractions in the learning environment	4.9
Varied teaching methods	Use a broader range of teaching approaches	3.8
Others	Any other suggestions	2.6

3.7   *The interplay of family income and online learning experiences*

Analysis of the relationship between family income and various aspects of online learning revealed significant correlations, primarily in the areas of available resources and learning environment (Table 2). Two-tailed Pearson's correlations were computed between family income and all relevant online learning variables. Family income showed significant negative correlations with several indicators of available facilities/equipment. Students from lower-income families were more likely to report that a lack of online learning facilities hindered their learning ($r = -.177$, $p < .001$), that online learning increased their financial burden ($r = -.179$, $p < .001$), that their online learning facilities lagged behind others ($r = -.202$, $p < .001$), and that their institution did not provide enough facilities/equipment for online learning ($r = -.141$, $p = .008$).

In terms of learning environment, a significant negative correlation was found between family income and the frequency of disruptions from surroundings ($r = -.165$, $p = .002$), indicating that students from less affluent backgrounds experienced more disruptions to their online learning.

However, no significant relationships were found between family income and students' reported advantages of online learning, disadvantages of online learning, or suggestions for improvement.

4   Discussion

This study investigated the experiences of tertiary students in Hong Kong during a large-scale implementation of online learning. While the rapid transition to online learning presented numerous challenges, it also offered valuable insights into the

potential and limitations of online education, paving the way for a more informed approach to its integration into higher education. The findings offer crucial considerations for designing and implementing effective and equitable online and blended learning strategies that remain relevant in contemporary educational contexts, particularly as institutions worldwide continue to navigate the complex landscape of digital transformation.

4.1 Digital equity and access

Our findings highlight the persistent digital divide, echoing concerns raised in international research (Aissaoui, 2022; Crocker and Kleitsch, 2023; Litchfield et al., 2021; Warschauer, 2003). While access to devices was generally high among participants, disparities emerged concerning reliable internet connectivity and conducive learning environments. Students from lower-income families reported greater financial strain associated with online learning and were more likely to experience disruptions. This aligns with recent studies demonstrating the disproportionate impact of the digital divide on marginalised communities (van de Werfhorst et al., 2022).

The negative correlation between family income and perceived adequacy of online learning facilities underscores the need for institutions to address these disparities through systematic support mechanisms proactively. These should include not only immediate interventions such as financial assistance for internet access, equipment loans, and access to quiet study spaces on campus but also long-term strategic planning for digital infrastructure development. Such provisions are crucial for ensuring equitable access to online learning opportunities and preventing the exacerbation of existing socioeconomic inequalities in education. Moreover, our findings suggest that addressing digital equity requires a holistic approach that considers both technical access and digital literacy skills, emphasising the need for comprehensive support systems encompassing training, mentoring, and ongoing technical assistance.

4.2 Pedagogical practices and teacher training

While students generally viewed their teachers' digital capabilities positively, there was room for improvement, particularly regarding the clarity of online instruction and the effective use of diverse online materials. This suggests a need for ongoing professional development focused on online pedagogy, including strategies for creating engaging and interactive online learning experiences (Archambault et al., 2022; Wong et al., 2024; Wong, 2024). The findings indicate that simply replicating traditional face-to-face lectures in an online format is insufficient for fostering deep learning and engagement. This highlights the need for a paradigm shift in conceptualising and delivering online education, moving beyond emergency remote teaching to purposefully designed digital learning experiences.

Contemporary training should emphasise not only the use of multimedia resources, collaborative activities, and effective online communication strategies (Means et al., 2010) but also the development of digital pedagogical content knowledge that enables teachers to integrate technology with subject matter expertise effectively. Furthermore, providing teachers with adequate support and resources for developing and delivering high-quality online courses is essential. This includes access to instructional designers,

technical support, and opportunities to share best practices within professional learning communities (Bates, 2019).

4.3   The learning environment and student engagement

The shift to online learning significantly altered the learning environment for tertiary students, revealing both opportunities and challenges in digital education delivery. While the flexibility and convenience of learning from home were appreciated, students also experienced frequent disruptions and difficulty concentrating. This underscores the need for thoughtfully designed online learning environments that minimise distractions and actively promote student engagement through innovative instructional design and interactive learning activities (Vo and Ho, 2024).

The recognised benefits of reduced travel time and costs, coupled with the potential for self-paced learning, irrespective of socioeconomic background, highlight the capacity of online learning to enhance accessibility and flexibility within higher education. These advantages should be central to the development of future online and blended learning models. However, realising this potential requires concurrently addressing digital equity challenges, ensuring all students have the resources and support necessary to benefit from these advantages fully.

Furthermore, online learning can lead to feelings of isolation and disengagement due to reduced face-to-face interaction (Rovai, 2002; Wong, 2024). Cultivating a sense of community and connection in online spaces is therefore crucial. Strategies such as encouraging active participation in online discussions, facilitating collaborative projects, and incorporating synchronous activities can help mitigate these challenges and foster a more engaging and inclusive learning experience. Finally, recognising that online learning may not be equally effective for all learning styles or subject matter, institutions should strive to offer a diverse range of online learning formats and pedagogical approaches to cater to the diverse needs and preferences of their student population.

4.4   Privacy concerns and online security

The strong aversion to turning on cameras and concerns about the security of video conferencing platforms underscore the importance of addressing student privacy concerns in online learning environments. As digital learning continues to evolve, institutions must prioritise data security and implement clear policies regarding the collection and use of student data (Almekhled and Petrie, 2024). Providing students greater control over their online presence and ensuring transparency about data privacy practices can help build trust and alleviate anxieties. Furthermore, offering alternative assessment methods that do not rely on webcam proctoring can address privacy concerns while maintaining academic integrity. These considerations have become increasingly pertinent as educational institutions continue to expand their digital offerings and integrate various learning technologies.

4.5   The future of higher education: beyond traditional models

The widespread adoption of online learning technologies has prompted a critical examination of traditional pedagogical practices in higher education. Contemporary research suggests an 'agile-blended learning' (ABL) approach offers a promising path

forward (Li, 2023). Unlike conventional fixed curricula or standard blended learning approaches, ABL integrates rapid adaptability in teaching delivery with flexible learning modes, emphasising the seamless integration of technology. This approach allows students to choose between attending classes in person or online while ensuring continuous refinement of course delivery based on student feedback and needs.

The implementation of ABL involves two key components: first, an agile approach that employs rapid planning-doing-review cycles, enabling instructors to continuously refine and adapt teaching methods based on ongoing student feedback. Second, a blended learning structure that strategically combines face-to-face and online activities to optimise learning outcomes. Studies by Wong (2024) and Tang and Zhang (2024) demonstrate that this dual approach enhances student engagement while providing the flexibility needed to accommodate diverse learning preferences and circumstances.

The success of ABL implementation requires careful consideration of institutional readiness, technological infrastructure, and faculty preparation, as highlighted in comprehensive studies by Li (2023), Tang and Chan (2024) and Wong (2024). As higher education institutions continue to evolve and adapt to changing educational landscapes, this approach provides a framework for developing responsive and effective learning environments that meet the diverse needs of contemporary students.

5 Conclusions

This study provides valuable insights into the experiences of tertiary students in Hong Kong during a significant transition to online learning, highlighting key areas for improvement in contemporary higher education. The findings accentuate the importance of addressing digital equity, enhancing teacher training in online pedagogy, creating supportive and engaging virtual online learning environments, and safeguarding student privacy and security. The accelerated adoption of digital technologies has catalysed a re-evaluation of their role in higher education, leading to more innovative and inclusive approaches to teaching and learning.

Moving forward, institutions must leverage these insights to develop comprehensive strategies that integrate online and blended learning approaches while prioritising accessibility and quality. Investments in robust digital infrastructure, continuous professional development for educators, and the design of flexible, student-centred learning environments are essential. Furthermore, addressing digital equity and inclusion is paramount to ensuring that all students, regardless of their circumstances, can benefit from digital transformation.

This study also contributes to the theoretical understanding of how digital transformation intersects with educational equity, pedagogical innovation, and institutional change. The findings support the development of a nuanced framework that considers the dual role of digital technologies as both enablers and potential barriers, particularly for marginalised student populations. This perspective emphasises the need to balance technological innovation with a commitment to equity and social justice.

From a policy perspective, the research highlights the need for institutional and governmental frameworks that promote sustainable digital transformation. These policies should address infrastructure deficits, support faculty training, uphold student privacy, and foster inclusive practices in online learning. Flexibility is crucial to adapt to ongoing

technological advancements while maintaining a focus on educational quality and student well-being.

While this study sheds light on many factors influencing online learning, future research should explore areas that remain under-examined. For instance, understanding how motivation – especially among low-income students – affects online learning experiences could inform strategies to enhance engagement. Further research is needed to evaluate and explore the long-term impacts of digital integration, the effectiveness of specific pedagogical approaches, and how institutional policies can better support students' psychological well-being in digital environments. Investigations into privacy concerns, the digital divide and the 'homework gap', and the role of ABL approaches in improving student outcomes would also be valuable for informing evidence-based policies and practices.

As higher education continues to evolve in an era of rapid technological change, this research underscores the potential of digital transformation to create more accessible, personalised, and effective learning experiences. By building on these findings and fostering adaptive strategies that prioritise both innovation and equity, institutions can ensure that technology enhances rather than diminishes the educational experience. Ultimately, the goal is not just to adapt to digital transformation but to shape it in ways that empower students and advance the broader mission of higher education. In the words of Nelson Mandela, "education is the most powerful weapon which you can use to change the world" – and in this digital age, it is our responsibility to wield this weapon wisely.

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Notes

1   US$1 is equivalent to approximately HK$7.8.