



The Importance of Offline Options for Online Learners

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COLLECTION:
OPEN LEARNING AND
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ABSTRACT

The popularity of MOOCs and MOOC platforms prompted some universities to develop their first online courses, while others experimented with the format of existing online offerings. Despite the body of research identifying cognitive, metacognitive, and practical benefits of printed materials, there has been a shift towards an approach that privileges online resources, reducing opportunities to access resources offline or in printed form. Online courses can be produced more quickly and cheaply than those providing both printed and digital options. They can also benefit learners in a society that values digital skills and literacies. This paper, informed by the principles of universal design for learning (CAST 2018), asks 'What are the benefits to students of offering downloadable/printable versions of online study materials and supporting offline study?'. It takes a phenomenological approach, exploring the experience of 100 postgraduate learners on an online course delivered on the FutureLearn platform. Data was extracted from a large dataset that included all the students' course discussion postings (N = 17,158). Data analysis identified the importance of the online/offline divide and showed that, as students' contexts change, the benefits and accessibility of online, offline and print versions shifts. Printed and digital materials support different ways of learning and can have an affective impact. These findings point to ways in which learning design, skills training, and technical changes might be used to increase the affordances of digital materials for learners.

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1 INTRODUCTION

1.1 ONLINE AND DIGITAL PROVISION

The explosion of interest in massive open online courses (Pappano 2012) prompted many universities to reconsider their online provision. The new platforms – Coursera, edX, Udacity, and those that followed – seemed very different to the virtual learning environments, (VLEs) such as Moodle and Blackboard, that universities were already using (Browne et al. 2010). MOOC platforms promised opportunities to educate thousands of learners in a new way. Courses could, according to the hype, be offered quickly and cheaply, providing staff with digital expertise, universities with international reputations, and citizens with access to a world-class education (Sharples & Ferguson 2014).

Many universities took up this exciting opportunity, experimenting with their first fully online courses. Those that were already expert online providers experimented with pedagogy, production methods, and format. ‘Open courses’ with no access charges made low production costs important, while their ‘online’ aspect reduced the need for print alternatives – MOOC platforms were digital by default. These platforms became part of the move by some providers towards ‘digital first’ and ‘digital by design’ approaches. Such strategies (adopted, for example, by the University of Sunderland, Ohio State University, and the multinational Pearson company) signalled a move away from print towards materials that could be accessed on mobile devices and updated regularly without incurring print costs.

Providing materials in both print and digital formats is costly, extends course production time, and creates confusion if one format is updated and the other left unchanged. Digital formats can be accessed worldwide and can help to prepare students for life and work in an increasingly digital world. They feel modern, there is no danger of bookshops or libraries running out of a required text, and there may be an assumption that students prefer reading digitally (Baron, Calixte & Havewala 2017).

1.2 DIGITAL AND PRINTED MATERIALS

These arguments suggest it is time for universities to fully embrace the digital. However, this raises numerous problems. One is the ‘digital divide’ – the gap between those who have the necessary technology, skills, and experience of using digital devices, and those who do not (Van Dijk & Hacker 2003). This problem can be particularly acute in low- and middle-income countries, where there may be limited access to digital devices, network issues, poor power supply and varying degrees of digital literacy (Dawadi, Goshtasbpour & Kukulka-Hulme 2024). Another issue is accessibility for those with disabilities, who may need materials designed with their needs in mind. A possible counter to these arguments is that university libraries and printed materials are also inaccessible to many so, if it is a choice between print and digital, then digital materials designed with accessibility in mind (Iniesto et al. 2022), may be the best option.

A significant problem from a learning perspective is that research over several decades indicates that reading print has cognitive, metacognitive, and perceptual benefits when compared to reading digital materials. Although experimental comparisons originally involved bulky monitors, recent research still shows ‘a clear picture of screen inferiority, with lower reading comprehension outcomes for digital texts compared to printed texts’ (Delgado et al. 2018: 34).

Numerous studies show lower comprehension for digital texts (Delgado et al. 2018; Singer & Alexander 2017). Display characteristics and the presentation format of digital materials appear to make them more difficult to study (Ackerman & Goldsmith 2011). Reading text from paper ‘seems to be consistently associated with deeper comprehension and learning’ (Froud et al. 2023). Reading digital materials places more demands on the limited short-term memory of readers (cognitive load) than reading from paper (Nichols 2020). Students report they concentrate more on printed material and are more likely to reread it than digital text (Baron, Calixte & Havewala 2017). When studying digital materials, they regulate their study time more erratically and are less accurate when they predict their performance (Ackerman & Goldsmith 2011).

This research appears to make a compelling case that students learn best from print. However, it uses experimental conditions to make direct comparisons between digital and print; findings

that are amplified by meta reviews based on studies using empirical approaches (Ackerman & Goldsmith 2011; Singer & Alexander 2017). Qualitative studies highlight the wider affordances of both physical and digital study, and contextual reasons why students may prefer digital materials.

A mixed methods study of business students recommended all online courses should make it possible to print out digital materials because ‘learners preferred print copies of text materials for reasons of portability, dependability, flexibility, and ergonomics’ (Spencer 2006: 33). A decade later, a five-country study categorised students’ reasons for preferring print or digital under six headings (Baron, Calixte & Havewala 2017). These were: emotional/aesthetic (including personal preference and enjoyment); physical (including legibility and search functions); cognitive (including memory and concentration); access to materials; convenience (including portability, and ease of use); and resources (both ecological and monetary). Another study identified 11 digital benefits, ‘ranging from flexibilities of time and place, ease of organizing and managing study tasks through to the ability to replay and revisit teaching materials, and learn in more visual forms’ (Henderson, Selwyn & Aston 2017: 1567). These studies draw attention to the day-to-day practicalities of student life. They also go beyond passive learning activities such as reading, and consider more active engagement with texts, particularly in terms of note taking and reflection.

Taking notes can involve comprehension, selection, organisation, and production – activities that help students to move information from short-term to long-term memory (Gourley 2021) and create a form of external memory (Piolat, Olive & Kellogg 2005). A large body of empirical work compares digital note taking with handwritten notes, mainly in the context of students writing lecture notes (Allen et al. 2020; Watkins et al. 2015; Morehead et al. 2019). One finding of this work is that verbatim note taking is associated with poorer academic performance than rephrasing material (Mueller & Oppenheimer 2014), so using copy-and-paste when making notes from digital sources may lead to text being only shallowly processed.

Although disadvantages of digital text for learners appear clear under experimental conditions, courses can be designed to address these challenges. Support with study strategies is important. Approaches that work well on paper or with emails cannot necessarily be transferred seamlessly to a digital study environment (Ackerman & Goldsmith 2011; Nichols 2020). Nichols suggests introducing learning strategies that improve cognition, as well as optimising page layout for on-screen reading, and making minimal use of hyperlinks, as these can lead to off-task activity. Essential book chapters and scholarly papers should be provided in print form, as they are often not screen-size friendly (Nichols 2020). This aligns with the principles of universal design for learning (UDL), which stresses the importance of accessibility, and recommends providing multiple means of engagement, representation, action, and expression (CAST 2018).

Empirical research draws attention to the drawbacks of digital materials for learners. Qualitative analysis identifies contextual benefits of these materials and suggests that learning design can be used to reduce these drawbacks. As producing both digital and print materials is costly, universities must decide whether, like cassettes and CDs before them, printed materials should be phased out. To make an informed decision, it is important to consider the student perspective and what might be lost in a shift to fully digital learning.

2 METHODOLOGY

This study addresses one aspect of this issue by asking: ‘What are the benefits to students of offering downloadable/printable versions of online study materials and supporting offline study?’

The study was carried out with a cohort of 100 part-time students enrolled on a 600-hour (60 UK postgraduate credits) module. The module was delivered by a distance-learning institution with 20 years’ experience of online degrees. Previously, modules on Moodle had included metadata that enabled creation of downloadable and printed study materials. This cohort was studying the university’s first qualification to be presented on the FutureLearn platform. FutureLearn was only accessible online and did not support automatic creation of downloadable and printed study materials.

Demographics of the cohort were: 58% female/42% male, the majority (62%) aged 40–54, 89% in full-time or part-time paid employment. Twenty percent had declared a mental or physical disability. Forty-six of the 100 students were new to the university in 2019, 1–7 students had started their studies in each year from 1999 to 2018, and 10 had begun studying with the university in 1998 or earlier. One student referred to completing her undergraduate degree at a distance in the period 1994–2005, typing up assignments on a home PC and receiving handwritten comments through the post in response. Another had been studying with the university for almost 50 years and remembered the introduction of computers. Group members therefore had diverse experiences of distance learning, and different expectations about the integration of online provision.

At the time the module was produced, the university was experimenting with a ‘digital by design’ approach that was interpreted by many to mean a move towards online only (Simpson 2018). The research question was therefore of direct relevance to everyone involved with the module. In addition, the students were postgraduates with a strong interest in technology-enhanced learning (TEL), who had chosen to enrol for an eight-month online module. This meant they were likely to reflect on the benefits offered by different formats.

This module was seen by some as an opportunity to adopt a more agile production approach, prioritising online materials. However, although module materials were all available online, students were given the option of downloading an alternative Word document version containing the module text. This was a significant scaling down of the university’s standard practice of embedding metadata within module materials, making them easily available in a variety of formats. Although students could have produced their own print versions, the FutureLearn presentation format would have required them to copy and style 427 individual pages, as well as transcripts for all audio and video material.

The module was developed using the conversational learning pedagogy that underpins the FutureLearn platform (Sharple & Ferguson 2019). This foregrounds opportunities to build shared understanding through conversation, including opportunities for asynchronous discussion alongside each activity and study material. It was possible to do well on the module by reading and reflecting on comments without adding to the discussion, but tutors emphasised the value to students of active participation, modelled this as good practice, and allocated marks for active participation. As a result, the 100 students and their tutors together posted 1,291,709 words in comments over an eight-month period.

The study took a phenomenological approach because the aim was to ‘examine the essence or structure of experiences’ (Tuffour 2017: 2) from the perspective of students without them framing their views in the context of a research study. Rather than asking students their opinions via surveys, interviews or focus groups – where questions would be shaped by the researchers’ assumptions – the focus was on issues raised in discussion by students as they worked through the module.

The initial dataset was therefore made up of all the comments (N = 17,158) posted on the module (each learning ‘step’ on FutureLearn has an associated discussion area – there are no separate forums). None of the module materials asked students about the benefits of downloadable and print resources, but there were activities that prompted shared reflection on online learning, the FutureLearn platform, accessibility, and individual experience of online study. References to hard copies, printed material, downloadable or offline materials were not confined to these activities but appeared throughout the module. For example, introductory material about mobile learning led to comments about where, when, and how individuals were studying; while an activity asking learners to reflect on their week prompted a comment about study preferences.

All references in the comments to student use or benefits of hard copies, printed material, downloadable, or offline materials were extracted and then grouped together if they dealt with related subjects. This produced a dataset made up of 247 comments (15,300 words) from 72 of the 100 students in the cohort. All these comments were accessible to the three authors of this paper in their role as educators on this module, with the expectation that one of the reasons for this access would be to consider and evidence future changes to the module. This data was stored securely and only accessible to researchers and educators approved by the

3 DATA ANALYSIS

Analysis of student comments involved an inductive approach driven by the research question, focusing on the benefits of downloadable materials and offline study that were identified by students, and the contexts in which these were important. This produced five coding categories:

- **benefits of digital materials** (including both theoretical benefits and those experienced by the student)
- **offline study on digital devices** (including searches and requests for downloadable materials and reasons for wanting these, plus explanations of how and why students had engaged in offline study)
- **benefits of hard copy** (including searches and requests for printable materials and reasons for wanting these plus explanations of how and why students had engaged with hard copy versions of module materials)
- **transcripts** (including all mentions of transcripts, why they were used, and how they could be used either in practice or theoretically)
- **note taking** (including how and why this was done, advantages and disadvantages of digital and or handwritten notes, and transitions from handwritten to digital notes)

Initial coding was carried out by one author and was then shared with the other two, who used their experience of both data and the context to consider whether the coding was confirmable, credible, dependable and trustworthy. The number of references to each issue mentioned in the analysis below is included as an indication of its importance to members of the cohort. As the comments were not responses to targeted research questions, the number of references it received should not be considered a measure of a subject's importance in a wider context.

3.1 BENEFITS OF DIGITAL MATERIALS

It was clear that members of the cohort were aware of the advantages of digital and online study material. Six mentioned that digital materials could improve accessibility with the potential for access anytime, anywhere. More specifically, one student commented that digital materials can all be accessed in one place on one device, but the device can be selected to suit the location. Digital was described as superior to printed materials because it offers new possibilities; is easier to use; the printed form offers no obvious advantages; digital versions can be changed more easily than print versions; the university does not have to pay for printing; and – in the case of downloadable materials – not everyone has easy access to a printer. One student had a more emotional response – paper is stressful.

Students were also aware that the benefits of digital materials are contextual, and their choices between offline digital study, online digital study and print reflected this awareness.

My eyes are too old to read long text documents on a mobile, but it is useful for consuming bite-sized content, for example videos or podcasts. ('Sally' – response to activity on benefits and challenges of mobile learning)

I don't actually work on the course material primarily online – I can't for very long these days. Mostly, I print it out and work offline because I love the big print of the word docs (thank you for that!) – and so my online activity doesn't even come close to what I do in total. ('Siobhan' – response to activity on data visualisation)

3.2 OFFLINE STUDY ON DIGITAL DEVICES

Despite their awareness of the advantages of online study materials, students were clear that there were contexts in which they needed access to these materials offline (not necessarily in printed form), primarily due to a lack of internet access. This was a problem in some countries.

The challenge with mobile learning in my part of the world (Nigeria) is the cost of mobile devices, data, and the issue of internet connectivity in remote areas or even

the quality of telecommunication infrastructure. ('Salimah' – response to activity on benefits and challenges of mobile learning)

However, it was clear that this can be an issue in any country. Internet access is dependent on context and is a major constraint on opportunities for online learning.

I am lucky that my internet connection is sorted now, but last year it was constantly on and off. ('Alice' – response to comment about inconsistent internet connection)

Six students noted that they had planned to study while travelling or taking their holidays and were limited by a lack of internet in taxis, trains, planes, and/or holiday homes.

I'm currently studying while I'm travelling on holiday in Spain. The space I have is far from ideal [...] I'm also relying on my mobile broadband data connection which isn't the best. It's been a good holiday, but far from an ideal studying environment. ('Malcolm' – response to activity about learning contexts)

Overall, it was clear that students' contexts often changed significantly during the nine-month module, meaning many were unable to access online materials for varying lengths of time.

The purchase of a new house in a new country has completed and we are now 'camping' with a few sticks of furniture, including a table and chair for me. However, I managed the first part of the course despite the different contexts: a kitchen in a flat next to a harbour; a dressing table in a horrid little bedroom in a horrid little house; another dressing table without a chair in a dingy little hotel bedroom. ('Rachel' – response to student query on learning locations)

Four students who wanted to study in their work environment had limited internet access there, or found it restricted by firewalls or security regulations. On the other hand, another found his work environment the best place to access online materials:

I don't have internet connection so am doing the activities offline hoping to transfer them to the FutureLearn platform once I get connected at work. When at work I study during tea break, lunch hour and for an hour after I finish my day tasks. Learning is more ideal for me at work because I have constant internet connection, I can watch the videos and search for more reference material though I have to keep away from pop ups on and notifications. ('Fadhili' – response to activity about learning contexts)

Some areas – parts of Wales and south-west England were both mentioned – receive no internet signal. The same is true of some buildings or rooms, particularly those with thick walls. Although no members of the cohort were studying in secure environments such as prisons, these were also mentioned as locations where internet access is not possible.

Expense provided another contextual limitation on internet use. Students sharing a connection with other family members often could not get online.

We're supposed to have really good internet connection but our provider is pretty rubbish and with both my adult children living at home, there's competition on who can suck the most bandwidth at any time. ('Naomi' – response to activity about learning contexts)

Others found it expensive to use mobile data or were limited by pay-as-you-go contracts. Not all providers offered consistent coverage and one student was dogged with technical problems over an extended period.

In addition to being available when an internet connection was not available, offline materials could be transferred to other file formats and devices. For some students, long files or papers were easier to read on an e-book reader. Offline files could be converted into audio files, used to highlight and annotate text, or integrated with comments in order to create a learning journal. They could also be used to create a searchable version of the module, as FutureLearn does not include a search facility – a significant limitation when navigating nine months of study material.

What I have done for each of these [course] modules, is collate all 9 weeks of the accessible course transcript into one big word document. Therefore if I need to find something I can use the 'Find' function and access the content instantly. ('Cameron' – response to activity on portfolio tools)

There was also an affective reason for using offline resources – making a clear distinction between work (online) and study (preferably offline).

3.3 BENEFITS OF HARD COPY

Some students did not simply want to be able to access materials offline, they wanted access to a printed version. This could be a preference – favouring offline reading or supporting their preferred way of learning. Sometimes the reason was practical, their online device was broken, the print on their mobile device was too small to read, or they found print easier to read than a screen.

I can't really read on a mobile (screen size vs eyesight). ('Naomi' – discussion of study methods used on mobile devices)

Many students could not access multiple devices, so digital study materials might require them to read long documents on a small phone or they might have no access to documents while commuting because their only access to a computer was at home or work. In these cases, printed copies were more versatile.

Printed copies had temporal advantages, they were available before the online site opened, allowing students to get ahead, and they remained available once the online site had closed. For some part-time students, the possibility of starting work on a module early or moving ahead of the cohort is very important. Some schedule their study around significant work, family, and caring commitments. Others have disabilities or health issues that limit their study speed.

As was the case with online materials, there was an affective element to student preferences. This could be pro-print: one student favoured offline reading, while another stated that printed materials supported their preferred way of learning. However, it could also be anti-digital – three students wanted to be able to take a break from technology. Print also offered different, and enjoyable, ways of studying.

I print out the week's module so that I can go through it offline. And I print the [assessment instructions] and any articles that I think might be useful. For many reasons like eyesight, old laptop trying to hang on a bit longer etc but one of these things is I find physically writing in the margins engages me more with the material than working with it digitally. Come to [assessment] time, I plaster the office floor with printouts and make connections and see overviews that I don't know how I'd do digitally. Lot of research on whole body learning and I must say I do like physically handling the material that way and I find it easier to move it about on the floor and find things easily ('Siobhan' – response to comment on fresh starts)

3.4 TRANSCRIPTS

An advantage of online content is that it can include audio and video material. These require transcripts if they are to be available in printable form. Although AI transcription services have improved significantly over the last decade, they still struggle to understand regional accents, unclear speech, and context-specific terms. They also omit crucial elements that are purely visual, such as graphs and diagrams. All audio and visual materials used in this module were therefore accompanied by manually produced transcripts. As one student noted, transcripts are labour intensive to produce.

The primary reason for providing transcripts is accessibility. World Wide Web Consortium (W3C) guidelines include the requirement to 'Provide text alternatives for any non-text content' (W3C 2023: [Guideline 1.1](#)). Five students noted that transcripts increase accessibility, not only in the context of disability. One commented that transcripts can be accessed when the video cannot – her phone had not been able to play video while she was travelling. Several students noted that transcripts are useful when sound cannot be turned up and are also usable in noisy contexts

where audio content cannot be heard. One of these students was accessing the videos while at work, another was in hospital for a week without headphones, and a third was studying while on a train.

Students were more likely to link use of transcripts to their learning than to access issues.

I usually like to read the transcripts of videos but on occasion I find watching the video adds something in the way it chunks and presents the information. ('Siobhan' – response to comment on video length)

Three students observed that transcripts can speed study up by providing an overview of content. This decision was made on a case-by-case basis, depending on the length of the video, the student's interest in the content, challenges presented by the material, and the importance of elements such as intonation and non-verbal cues. These students viewed transcripts as maps of the video resources, which could be used to locate sections the student considered relevant or used as reference material that removed the need to watch a video more than once.

Students also noted that transcripts could support understanding. Two related this to hypothetical situations in which a non-native speaker would use transcripts to ensure they had followed the speaker's meaning, to identify and check the meaning of unfamiliar terms, or to run the entire transcript through Google Translate. One student reported using transcripts when they found a speaker's accent difficult to understand. Another two used transcripts to help them focus their attention, providing the same information in two modalities so they could switch between the two.

Transcripts also provided support for notetaking; this was reported by five students. A transcript could form the basis of a set of notes on the session – students underlined or highlighted sections they found particularly relevant when watching the video. They also cut and pasted sections of the transcript into notes they had created or used the transcript as a resource when making notes after watching the video.

Overall, 17 students referred to their use of transcripts. Of those, 14 described ways in which they had combined their use of transcripts with their use of videos, treating the transcripts as an additional, rather than an alternative, resource. Two did not specify what they had done, and only one stated that he had used the transcripts rather than the videos – a decision based on the material, the context, and personal preference.

3.5 NOTE TAKING

Student use of transcripts to support note taking indicates that support for offline study is not simply about passive learning activities such as reading text and watching videos. Learning is an active, participative process. Taking notes to record information, shape understanding, and aid reflection is part of that process.

Several students commented on their reasons for choosing physical or digital approaches to note taking, or a combination of both.

I'm a compulsive scribbler, and I continually switch between scribbling something down in a physical notebook and typing notes in OneNote (they all end up in OneNote eventually). With two screens I can keep one screen for the stuff I'm focusing on, and another screen for wandering off on study tangents or checking a source. ('Sally' – response to activity on important aspects of learning context)

An advantage of digital tools such as OneNote and Evernote is that different media can be included, allowing students to add slides, images, annotations, sections of resources, and audio recordings. Notes, files, and links can all be stored, edited, and arranged in one place. This multi-modal capacity was commented on by seven students, some of whom used these digital tools at work or had been introduced to them earlier in their studies.

I use a variety of note taking tools, including OneNote and pen and paper (am a stationery nerd). I've been playing with the portfolio tool – mainly because I want to evaluate it against another tool we want to use at work, but I'm not wildly impressed so far. I may use it to present a 'neat' version of sketch notes and summarised

thoughts. OneNote is my grab-bag of references, ideas and sketches. ('Sally' – response to activity on portfolio tools)

Another advantage of online tools is that notes can be accessed on any internet-enabled device. This meant students did not have to remember to carry a notebook as well as a digital device – they had their notes to hand whenever they had internet access. They were also able to suit the device to the task – searching for material on a tablet, collecting images and audio on a phone, and arranging data in a spreadsheet on a laptop, for example.

I have another screen that wasn't being used I get I can use it to easily write notes as I usually have a hard time switching screens to study and take notes. ('Fadhili' – response to comment on dual screen use)

However, having the flexibility to move between tools in this way not only meant having access to a lot of technology, but also having the space available to work with multiple devices and screens.

Students were also aware of some of the downsides to taking notes digitally. Four noted the difficulties involved in making notes on small devices. Typing and reading extensive notes on a phone is not easy, and the screen size makes it challenging to study a resource and make notes at the same time. Voice recognition software addresses some of these challenges, but only in contexts where it is possible to dictate undisturbed. Three students were consciously making the transition from physical note taking to digital note taking. Others moved between digital and physical note taking, depending on the context.

In the week, I read on iPad in the kitchen before and after work and use post-it notes for (rare) lightbulb moments. At work, to print articles; highlighters are my best friends. ('Naomi' – response to student query on learning locations)

In some cases, the decision about how to take notes was based on affect. Some students simply preferred one approach or another – for example, two students enjoyed choosing and using stationery. In other cases, the reasons were much more closely related to learning. Physical note taking can support learning and reflection (three students), help to structure ideas (two students), support creativity (one student), aid concentration (one student), help consolidate learning (one student) and give a physical aspect to the module (one student). The importance of handwritten notes came up in several contexts – one student wrote notes by hand and then scanned them for online reference.

Digitizing text based content wouldn't work for me personally. I like a paper copy to scribble on and annotate. I think the key is that there's not a one size fits all approach to learning and teaching. It's about the right tools for the right job. ('Malcolm' – response to activity on definitions of TEL)

For some students there was also a temporal element – choosing the right stationery or physical set-up signalled the beginning of study. Creating and arranging physical notes signalled that study was underway and things were being achieved. Clearing up post-it notes, removing piles of printouts, and cleaning a whiteboard indicated the end of a phase of study.

After each module I do a cathartic clear out of the office and wipe all the white boards clean because after the [assessments] go in, the office floor has piles of printouts and notes and white boards all over the place. It's like navigating an assault course! ('Siobhan' – response to comment on fresh starts)

One student explained how she achieved similar effects online – choosing and downloading appropriate software at the start of the course and then building up virtual heaps of paper during her studies.

4 DISCUSSION

Like the study of digital technology in university teaching and learning carried out by Henderson and his colleagues (2017), this study is part of a move for research to pay more attention to 'what students do as they live their lives' (Stokoe, Benwell & Attenborough 2013:

76), recognising that it is difficult, and often unhelpful, to disentangle study from other life experiences. This approach reveals that the seemingly clear-cut distinction between digital and print study materials is more complex than it initially appears. Although students are aware of the benefits of digital resources, they are also aware that these benefits are contextual – and their study context rarely remains constant. As well as distinguishing between digital and printed materials, students are aware of significant differences between online and offline digital materials. Study materials are not simply used as part of a passive learning process but can support more active, embodied, and enjoyable approaches. Together, these insights suggest ways in which courses can be designed to make the best use of digital resources and draw attention to some of the important roles that printed study materials can still play.

The opportunities offered by digital learning materials are well known – the ability to study anywhere and at any time is often cited. However, this does not represent the reality for many students. Access to digital materials is dependent on context. If materials are only available online (and FutureLearn’s 17 million registered users do not have access to an offline version of the platform) then study is difficult or impossible without an internet connection. For campus-based students with access to a stable technological infrastructure, this may not be a significant problem. Students using digital materials, though, are likely to be studying at a distance and do not necessarily have continuous access to a reliable and affordable internet connection.

The ability to study anywhere and at any time is also dependent on having a suitable device available. Even when a desktop or laptop computer with an up-to-date operating system is required for enrolment, this is not necessarily available at the point when learners have time to study. For those studying on a smartphone as they commute, long passages of text can be difficult or impossible to read, no matter how much it is magnified, while video and audio may not be accessible without headphones.

For many online learners, their context changes frequently. It changes throughout the day as they move between home, travel, and work. It changes when other people enter their environment, taking up bandwidth, requiring access to shared technology, or prompting a move to a space with no internet access. If a module requires months of study, then context may change for work trips, family holidays, changes of location, and even house moves. Digital materials support study in a variety of places, but the contexts where effective study is possible are far from ubiquitous.

This variety of contexts highlights the important divide between digital materials that are available only online and those that are available both online and offline. This distinction is not made in empirical literature, which takes care to ensure that all learners are presented with the same types of material in the same contexts. For example, Delgado’s meta-analysis considers papers in which ‘Reading materials are comparable across media in terms of text content, structure, and presence of images’ (Delgado et al. 2018: 26).

In many contexts, the online/offline distinction would not be important – materials can be downloaded, copy-and-pasted into a document, or may be available offline in an app. Some online courses originally designed for face-to-face students consist mainly of extensive recorded lectures and long readings, meaning there are relatively few resources to download (although downloading long videos requires a lot of free storage space). However, courses designed first and foremost for online students may weave together activities, short videos, reading and discussion. In these cases, a copy-and-paste approach would be a significant undertaking. For example, if no printable version had been available to the cohort considered in this study, each student would have needed to spend several hours on the tedious and repetitive task of downloading 427 individual pages together with audio/video transcripts.

Transcripts are used by students in a variety of ways, some of which rely on the transcript being available in a downloadable form rather than embedded within the video as subtitles or as an automated translation (as is often the case with YouTube videos). Although the primary intended use of transcripts is to make videos accessible to those who cannot hear the soundtrack clearly, students use them to support learning in many ways. Having access to the same information in two modalities provides different ways of structuring and thinking about the ideas within it. A transcript can support navigation, clarify ideas, provide spellings of names and contexts that enable students to follow up on material, and help with note writing.

Student accounts of their learning with printed materials draw attention to the active, embodied approaches these materials can support. One of these approaches is note taking. Empirical studies of note taking typically focus on how the activity is carried out in the time-limited environment of the synchronous lecture where students are required to split their attention between listening to the educator, and representing what is being said. In this multi-tasking context, digital comes a poor second to handwriting (Allen et al. 2020; Watkins et al. 2015; Morehead et al. 2019). However, the experience of online students is different. For them, opportunities to use the internet while taking notes do not necessarily create ‘an environment full of potential personal distractions’ (Allen et al. 2020). Instead, they provide ‘opportunities for wandering off on study tangents or checking a source’ (‘Sally’). A digital environment offers possibilities for collecting and structuring a wide range of media over time, rather than being restricted to what can be represented with a pen on paper while the lecturer is still speaking.

Although some students expressed strong preferences for either print or digital formats, many moved between the two, making choices dependent on what they were doing and the context in which they were doing it. They described learning techniques they had developed using print or digital materials, such as Siobhan’s whole-body approach to assessment preparation that involved plastering her office floor with printouts to make connections and see overviews, or Fadhili’s practice of completing activities offline, then transferring them online at points when he had internet access. They also used print or digital media to give shape to their studies – setting up their digital workspace or purchasing a new set of stationery at the beginning, clearing boards and throwing away print-outs at the end.

Identifying these practices suggests actions that universities might make to support a move away from print and towards digital. This is not necessarily a binary – in some cases it takes very little effort to provide students with the choice of modalities that support accessibility (CAST 2018). Moves towards a digital-only or digital-first approach need to take into account the findings of empirical research. If the same material is presented in the same way, then students will find it easier to learn in printed form. ‘Ultimately, the questions of on-screen versus print come down to how an on-screen experience can be provided to maximise student success and equip students for the future’ (Nichols 2020: 40).

Changes can be made to course materials, learning design and the learning environment to make students aware of the opportunities offered by digital and to enable them to benefit from those opportunities. Skills that can be taught include:

- Customising a digital environment – choosing default fonts, selecting font size and enabling magnification.
- Note taking – purpose, which content to select, different ways of structuring notes, ways of bringing different media together meaningfully, disadvantages of simply cutting and pasting.
- Cognitive skills – searching and navigating online, using different modalities to reinforce learning, using digital tools to support reflection on material.
- Time and resource management – paying attention to context, scheduling online work for times with internet access, printing out longer pieces when necessary.
- Adaptation – ways of replacing offline practices with equally successful/enjoyable online practices.
- Communication – ways of sharing successful ideas and practices.

These can be designed into a single course or introduced across a qualification.

5 CONCLUSION

The contribution of this paper is that by taking a phenomenological approach and centring the lived study experiences of students, the study has identified benefits of offering downloadable/printable versions of online study materials and supporting online study. These resources and support are particularly valuable to students when they are in a context where they are unable to study online. As university courses run for many months, students will change contexts multiple times and there may therefore be many occasions when they cannot access online

materials. This can be particularly problematic if their course is based on a platform, such as FutureLearn, which is digital by default and does not make it easy to access course materials when offline. Although the current study is limited in that participants were postgraduates and most were experienced users of educational technology, its findings suggest that changes in context can limit the utility of online materials for any student.

This study highlights the importance of the online/offline divide, as well as the value of providing video and audio transcripts not only to support accessibility but also to provide opportunities for varied approaches to study in different modalities. The students' diverse lived experiences provide a nuanced view of the benefits of both hard copy and digital materials. Understanding these benefits has the potential to underpin changes to learning design that enable learners and educators to take full advantage of the possibilities offered by digital materials, with the potential for a flexible approach grounded in UDL to increase equitable participation in learning.

COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

Three authors contributed to the content of the article, supporting the study theoretically and methodologically (Ball, Ferguson and Perryman), and discussing the data and coding (Ball, Ferguson and Perryman).

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