HOW HANDHELD DEVICES TRANSFORM, AUGMENT AND REINFORCE UNIVERSITY STUDENTS' STUDY HABITS: EMERGING THEMES FROM A THREE-YEAR STUDY

S. Cross

The Open University (UNITED KINGDOM)

Abstract

Ownership and use of handheld devices for university study and revision is transforming learning habits and posing new learning design and pedagogic challenges to educators. How is seamless learning affecting study habits, what is the impact of simultaneous multiple-device use, and can existing learning platforms cope with new demands? Whilst surveys in the UK, US and other countries have helped monitor trends, there remains a paucity of comparably sized analysis of qualitative data. Such insight is essential to help interrogate and explain observed trends and to probe the new 'opportunity time' that mobile learning creates. This paper will present the results from a thematic analysis of open-comment survey data collected from UK distance learners. This work was conducted as part of the long-running E-Pedagogies Project which began in 2012. The dataset includes undergraduate learners from all subject disciplines and used an emergent coding scheme that was framed by key issues identified in a literature review, an analysis of initial learner interviews, and previous statistical analysis of the survey by the authors. The paper focuses on three learner groups identified in the statistical analysis: those using devices for a wide range of study purposes, those using devices for a limited number of purposes, and those deciding not to use devices for study. The paper will present findings that unpack differences as to how, why and where handheld devices are used, highlight examples of innovative, necessary or unusual study practice reported by learners, and summarise what changes learners want to see.

Keywords: m-learning, mobile learning, study space, tablets, smartphones, e-readers, higher education, distance learning

1 INTRODUCTION

Ownership and use of mobile technologies by Higher Education learners continues to increase in distance and campus-based learning contexts [1] [2] [3]. As a result, many learners find themselves with more choice about where and when to learn, whilst for others, especially those in full-time work, such an increase in 'opportunity time' represents the difference between being able to find enough time for study in their daily routine and falling behind or withdrawing from a course. Furthermore, learners differ greatly in their digital skills so not all will necessarily aspire to achieving seamless learning practices [4], at least not at present, and effective utilisation of these devices even by experience learners or their teachers is not a given [5]. The role that mobile technologies have in Higher Education therefore represents a strategic area of research [6].

The concept of anytime-anywhere access to learning [7] has become commonplace over the last decade, yet at a practical level every student learns sometime and somewhere. It is therefore essential to understand the patterns of mobile study and the reasons behind these choices. Cross et al. [1] use the term 'flow of places' to describe how learners move between locations – a concept aligned to that of seamless learning [8] [9] – and the term the 'place of space' to encapsulate issues associated with 'how [learners] exert their agency …, and when and to what degree they grant [the] virtual [learning] place access to the real places in which they study' (p.237) [1]. Access to learning via handheld devices is something that is either intentionally sought or enforced [10] and even technologically savvy learners can encounter challenges [11]. It is imperative to understand what different learner groups think the benefits of access are and what can be done to support them.

Handheld devices are now capable of supporting learners in the full range of learning tasks including assimilative tasks such as reading text and watching video, communicative tasks like using forums or social media, productive tasks such as note-taking or writing assignments and tasks that help consolidate and organise learning [12] [13]. However, whilst handheld devices are capable of supporting learners in these ways, the implementation by teachers and university VLEs can vary greatly and

thereby limit, discourage and challenge learners wishing to use or adapt learning resources to their own needs. For example, if a course textbook is not supplied in E-pub format then it becomes much harder to view on an e-reader. As a consequence, survey results may show lower use of e-readers which may erroneously be interpreted as signifying low demand or potential for future use.

However, there remains a significant variation in learner use and attitudes [2] [14] [15]. Previous research by the E-Pedagogies project has shown it likely that there are learner sub-groups that could be identified using measures associated with the number of locations in which handheld devices are used and the number of study tasks [1]. This also found that distance learning students are more likely to notice a positive impact on their learning if they use handheld mobile devices in more locations and for a greater range of learning tasks. Three variables – the number of different study locations used, the number of study tasks performed, and a change in study habits – are correlated and are predictors of students attributing their use of handheld devices with an improvement in quality of work and finding it easier to access materials [1].

Systematic reviews of early research into mobile learning have found that the majority of studies submitted to journals had small sample sizes, tended to focus on user acceptance, often involve early adopters, and reported mostly positive results [4] [10]. There have also been many large-scale quantitative studies surveying student use and attitudes and these report increasing sophistication in the use of handheld devices [2] and that the majority of campus-based learners agree that handheld learning technologies can help them spend more time studying [16], However, only 10% of mobile learning research relates to distance and adult learners [17] and comparatively little has focused on larger-scale qualitative analysis– two opportunities at which this paper is positioned. This insight is essential to help interrogate and explain observed trends and to probe the new 'opportunity time' that mobile learning creates.

- RQ1. Can distance learners be grouped according to their mobile learning behaviour?

- RQ2. How does each group talk about mobile learning and does this differ between groups?

- RQ3. What of emerging opportunities for further support are learners asking form?

2   METHODOLOGY

This paper uses open comment data collected as part of the Open University's E-Pedagogies Project. The questionnaire survey instrument was initially developed in 2012 and has been updated and revised for each iteration since [18]. Undergraduate distance learners at The Open University (UK) were surveyed in the spring of 2013, 2014 and 2016 [19]. whilst postgraduate students were surveyed in 2012, 2014 and 2016. The Open University is the UK's largest distance learning institution teaching adult learners resident across the UK and abroad. Over the last decade has shifted to a predominantly digital and online teaching model whilst maintaining small tutor groups and the detailed personal tutor feedback learner receive at each module assessment point.

The E-Pedagogies project was established to understand the mobile practices and needs of learners in the same year the university launched its OU Anywhere App – an app intended to help make course materials and media available on handheld devices. Between 2012 and 2016, over 1800 learners have responded to the E-Pedagogies survey and stratified sampling has ensured the composition of the respondents has remained comparable. Response rates to the online survey have been between 14% and 18% and, overall, are considered to satisfactory represent the overall learner cohort (whilst there is a slight overrepresentation of older learners this is a common in surveys of distance learners).

The survey comprised questions about ownership, use for specified leisure activities, use for specified learning activities; locations of use; perceived change in study habits; impact of use on learning, and reason for purchase. Some questions asked separately about use of tablets, smartphones and e-readers. A core set of questions featured in all surveys whilst questions were added or adapted in response to the changing use and research context. Open comment questions were also included in the survey. This paper analyses answers to three of these questions: (A) 'What benefits, if any, are there in using a handheld device for you OU study activities?' (B) 'What could the OU do to make using a smartphone, tablet or e-reader for any aspect of your study easier' and (C) 'Describe any changes you would like to see and, if you have one, give an example.'

Given the exploratory nature of this analysis it was decided to (1) focus on responses from a single survey – that conducted in 2016 – and (b) to use only responses from undergraduate learners – so as to avoid potential issues due to differences between the post graduate and undergraduate curriculum and teaching approach. The resulting data comprises 446 responses.

Two-step cluster analysis was used to determine the number of distinct learner groups based on how they used handheld devices for study. This was performed in SPSS using two measures derived from answers given elsewhere in the survey: number of study tasks performed on handheld devices and number of location (types) in which handheld devices were used for study. The output of the cluster analysis was used to assign the comments of each respondent to a group and this dataset was subsequently loaded into Nvivo. An open coding approach was adopted [20] based on a start list derived from the literature review and analysis of earlier surveys. Codes were refined and merged using an iterative process that concluded when stable key themes had been identified.

A total of 218 learners responded to question A (see above). 416 codes were made against 106 nodes with subsequent iterations reducing the number of nodes to 34. Both questions B and C asked about suggestions for future use so, for the purposes of this analysis, responses from learners were combined (n=211). 236 codes were made against 45 nodes. These data were reviewed with reference to each key theme and sub-theme. The number of learners coded against each theme were also counted and expressed as a percentage of the total who responded to the question. In so doing a contextualised and integrate understanding of the data was achieved.

3 RESULTS

3.1 Identifying mobile learning groups

An exploratory Two-step Cluster analysis was performed to determine sub-groups of learners using two key indicators of mobile learning behaviour – number of study tasks (from 0 to 12) and number of study locations (from 0 to 7) [1]. The model determined three sub-groups (Table 1) with a good to fair measure of cohesion and separation. Learners in Group 1 do not use handheld devices for learning and comprise just over a third of learners responding to the questionnaire. Those in Group 2 use handheld devices for a select number of tasks – on average 4.6 tasks out of the possible 12 asked about in the survey – and over a limited range of study locations. Closer inspection of the data indicates that two of the locations this group commonly use are 'home quiet space' and 'home communal space.' Learners in Group 3 perform a comprehensive range of learning tasks on their handheld devices – on average 9.6 out of 12 tasks - across a wide range of locations (on average 5.4 out of 7 different types of location).

Table 1. Learner groups

	Group 1 No use	Group 2 Selective use	Group 3 Comprehensive use
Group size	164	141	141
Average number of study tasks performed on a handheld device (max. 11 tasks)	<0.1	4.6	9.6
Average number of location types in which handheld devices were used for study purposes (max. 7 locations)	<0.1	3.1	5.4

Table 2 shows how learners in the three groups responded to questions in the survey that asked about whether using handheld devices had improved the quality of their work, had a positive impact on learning, changed study habits and made it easier to access materials. Table 2 also shows how the groups differ with respect to whether learners want to see greater future use of smartphones, tablets

and e-readers in their studies. These differences are statistically significant and appear to confirm three distinct types of mobile learning behaviour.

Table 2. Use and attitudes towards handheld technologies for learning.

	Group 1	Group 2	Group 3
Use improved quality of assignments	<2%	14.0%	44.6%
Use had positive impact on learning	<2%	43.3%	73.8%
Use made it easier to access materials	<2%	50.0%	80.8%
Experienced a change in study habits	<2%	33.8%	51%
Would like greater use of smartphone in future	12.8%	20.5%	38.1%
Would like greater use of tablet in future	12.8%	33.3%	48.9%
Would like greater use of e-reader in future	8.3%	9.9%	23.0%

Further analysis reveals no statistically significant differences between the groups with respect to eight common socio-demographic measures (Table 3). This shows that the degree to which learners are using handheld devices seems unrelated to their age, gender, previous highest level of educational achievement, discipline area, academic year, UK region of residence and whether or not they have a disability or have just joined the university (new student). Socio-demographic factors therefore do not appear to account for the differences in behaviours observed in Tables 1 and 2.

Table 3. Results from Chi-Square analysis of eight socio-demographic measures to determine any significant differences between learner groups. N=446

	X^2	d.f.	p
Age (Grouped) [1]	7.315	8	.503
Previous Qualifications	4.890	8	.769
Faculty [2]	19.023	12	.088
Gender	1.520	2	.468
Academic year	5.139	4	.273
Disability (Yes or No)	.664	2	.718
New or Continuing student	.986	2	.611
UK region of residence [3]	11.620	24	.984

* Significant at 0.05 level. [1]Five age groupings were used: 25 or under, 26-35, 36-45, 46-55, 56 and over. [2]The university has six faculties at time of survey. [3]For administration purposes the university divides the United Kingdom into 13 regions.

3.2 How learners talk about the benefits of mobile learning

Having identified three distinct learner groups, qualitative analysis of open comments was used to determine how each group talked about their mobile learning experiences and whether there are differences between the groups. This section analyses over 200 responses to the question asking about the benefits of mobile learning. Learners were invited to write their responses in a free-text open comment box. Consequently, the responses received give an indication of what the learner considers important and the language they chose to express this. The majority of mobile learning users belonged to Group 2 and Group 3 and so this section focuses in particular on the similarity and difference between these two groups.

Findings show that learners talked about their experience of study space in two distinct ways. The first employed a language of extension to describe how they were learning in 'more places', at 'more times,' or in new places where it had not been practicable to study before such as on holiday, when in bed or in the garden. Group 2 used this language slightly more often than Group 3 (18% compared to 14%). The second way of talking about study space related to the ubiquity of study opportunity. Learners talked about being able to learn 'anywhere', 'anytime,' 'everywhere', 'always', or being able to pick up where they had left off on another device. This is the sort of language associated with seamless learning and was much more frequent in Group 3 (34%) than Group 2 (20%). One learner, for example, wrote '[the] app automatically restarts where the previous session I left ended' and another 'I have multiple devices. What I complete on one, I [sync] and can pick up on any other device.' Also, Group 3 learners talked much more about the benefit of incidental or opportunistic learning (13% compared to 1%) – of being able to carry 'all' my materials, even all previous module materials, potential to use in unexpected circumstances or without having to prepare or plan their mobile learning beforehand. A further four learners in Group 4 (4%) this resulting in more frequent study but that such study sessions were shorter. In summary, the conception of anytime anywhere learning is more apparent in comments from Group 3 learners, whilst Group 2 remain focused on how handheld device can deliver incremental extensions.

Group 2 learners more regularly commented on how handheld devices represent a more efficient use of time and have utility as the last or only option. 20.2% talked about being able to access module material more quickly, more flexibility, or to 'save time' compared to 10% of Group 3. Likewise, 14% of Group 2 (compared to 5% of Group 3) commented on how handhelds could be useful when having to be 'away' from their desk or home, when they were 'tired' of their desktop, when their home internet dropped out, when reading in a dark place (such as travelling at night) or as a back-up if another family member is using their computer. This emphasis on handhelds as a means to study quicker or as a last resort perhaps indicates a greater underlying sense of reluctant engagement in Group 2.

Portability was a theme mentioned often by both Group 2 and Group 3 (23% and 26%). However, whilst Group 2 learners more regularly framed the benefit of portability in reference to *not* needing to carry books, Group 3 learners talked about the direct benefit of the smaller and lightweight form factor. Similar proportions of both Group 2 and Group 3 learners (9% and 7%) talked about a positive affordance of handhelds that made it the preferred option. This included ability to work silently (such as when family are sleeping), more discrete, easy or easier to use than other technologies, or no need for wired internet.

There were distinct differences in what types of study task learners in each Group choose to talk about. Group 2 learners tended to focus on tasks relating to administration such as checking assignment marks or tutorial times (14%), communication such as checking emails or group forums (10%) and consumption of video or audio media (12%). Mention of these by Group 3 learners was rarer (3%, 3% and 5% respectively). Conversely, Group 3 learners more frequently talked about annotation and note-taking (6% compared to 3%) and only Group 3 learners mentioned using devices for revision tasks (6%) and for study planning (2%). There is a difference, therefore, as to which study tasks learners in Groups 2 and 3 chose to place emphasis.

Two further themes were mentioned only by learners in Group 3. The first related to what are termed emotional or wellbeing benefits (11%) such as enabling them to feel more connected to other students, helping them not fall behind when away from home, easing stress associated with having ot be somewhere with access, and as solution to health problems preventing them carrying heavy books. Whilst other learners may have had emotional or wellbeing issues in mind when responding, the key point here is that only Group 3 learners are explicitly articulating these benefits. The following quotations are illustrative of these comments:

> '[There is the] ability to access OU materials whenever possible resulting in less stress associated [with] getting access and time to revise'

'It keeps me connected with my study schedule at all times [and] allows me to interact with the community and feel less on my own.'

'…When my broadband connection was down, I was able to use the 3G data on my phone to continue my studies, so it was a nice *safely net* to have'

The second theme only mentioned by Group 3 learners relates to environmental benefits. Whilst only a few (1%) of learners explicitly mentioned that study with handheld devices 'uses less power' or 'saves paper' it is noted because early research into the use of e-books often dwelt on potential environmental benefits. Such concerns do not appear common in the learners surveyed for this study.

3.3   Emerging opportunities

Learners from all three groups (n=236) offered a range of suggestions when asked what more could be done to support the use of mobile technologies for study purposes. However, whilst comments from Group 2 and 3 were generally constructive, around half of those in Group 1 wrote that improvements would not matter because 'I wouldn't use them anyway.' Reasons given for not using handheld devices were that there was no perceived need or benefit, learners preferred using printed materials or larger screen desktop or laptop computers, handheld device screens were too small, they did not use or saw a need to use functionality associated with handheld devices (such as social media) and that their lifestyles did not require them to be 'mobile.'

The most common suggestions for making it easier to access and use content were: (1) To provide a more effective learning app with greater functionality, device compatibility and stability. Whilst some materials were available to download, learners wanted to see an app which gave them access to student and tutor group forums, study planners, offline activities and materials, and their assessment scores and feedback. (2) Consistently provide all written course materials in e-book format. Written materials comprise the key method by which the university delivers teaching at distance. (3) Greater consideration of the smaller but touch-enabled screen in the design and layout of course materials. (4) Greater availability of course text in audio format and greater use of video and audio materials in courses – including access to recordings of live online and face-to-face tutorial events. One learner even expressed interest in an app for their Smart TV.

An additional observation is that, when mentioned, each group most commonly asks for greater support in performing learning tasks currently associated with the next group. Those in Group 1 wanted support in doing tasks currently seen as a key learning benefit by Group 2 (see Section 3.2) such as accessing forums, assignment scores and study diary. Those in Group 2 wanted support in doing tasks presently seen as a learning benefit by Group 3 such as revision, practice tasks and access to a weekly study guide. Learners in Group 3 wanted more support for integrating and seamless learning , such as having all activities and materials available on all devices and wanting the ability to synchronise note-taking. This observation is based on just 29 comments, however, it suggests that further research into the multi-stage sequence of uptake and use of devices – as crudely evidenced by the three groups identified - could be helpful in offering more personalised support to learners.

CONCLUSION

The preceding analysis shows that UK distance learners can be grouped into three distinct types of mobile learning behaviour based on number of different study tasks and study locations at which they use handheld devices for learning. These groupings cannot be explained with reference to socio-demographic factors and quantitative data about learning provides only a partial picture. Qualitative analysis of comments from large numbers of learners – such as the open comment data gathered from online surveys – offers an additional perspective.

There are differences and similarities in the way that learners using handheld devices for a selective range of learning tasks and for a comprehensive range of tasks talk about the benefits of use. This provides some insight into what they consider important and how they view and negotiate the place of online learning space [1] in their studies. Of particular note is that learners using handhelds in the greatest range of locations (Group 3) most frequently talked about benefits associated with seamless learning, and reflective and productive practices such as revision and note-taking. Further in-depth interviews of a sample of respondents would be required to probe these preliminary observations. Furthermore, analysis of what further support learners would like with respect to using handheld devices

for study purposes suggests that simply providing access to prepared course media is not enough. Learners are looking for better access to forums, assessment feedback, practice activities, recordings of missed teaching sessions such as tutorials, study planning information and revision activities.

ACKNOWLEDGEMENTS

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