Distance Learners' Use of Handheld Technologies: Mobile Learning Activity, Changing Study Habits, and the 'Place' of Anywhere Learning

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Abstract

This study investigates how and where distance learners use handheld devices and the impact this has on learning habits, access to learning content and quality of work. It analyses the spatial dimension of anytime-anywhere learning and, with a focus on anywhere learning, it explores students' ongoing negotiation of the flow between and across study locations. The study concludes by proposing two new concepts: the *flow of places* and *place of space*. These should help direct the framing of future studies into the places, spaces, and mobility of formal and informal seamless learning. A dataset comprising 446 responses from undergraduate students enrolled at the UK's largest distance learning university was analysed in respect to three research questions. All age groups, study levels, and disciplines were represented. Five key findings are: most students now use handheld devices for study-related learning; the distribution of study-related learning tasks was similar in all seven study places; there is a strong, statistically-significant correlation between the number of study places in which handheld devices are used and the number of study task types performed; two fifths of students using a handheld device for learning have noticed a change in study habit and benefit to learning; and multiple regression analysis shows three variables (number of study places, number of study tasks, and change in study habits) are predictors of finding it easier to access learning materials and improved quality of learners' work.

Keywords: mobile learning, seamless learning, study space, handheld learning technologies, anywhere learning, distance education.

Introduction

The concept of anytime anywhere learning is over a decade old (Attewell & Savill-Smith, 2005) yet there remains much to be done in understanding what anywhere learning looks like and whether changes in the geographic reach of handheld technologies is impacting on study habits and quality of learning. As ownership and use of mobile handheld devices increases (Brooks, 2016; Newman & Beetham, 2017), how are the places of learning being transformed?

The potential contribution that mobile technology can make to Higher Education teaching and learning has become one of the most important and strategic areas of research (Ally & Prieto-Blazquez, 2014). Educators urgently need to understand how learning designs and teaching models must be reconfigured such that they are better compatible with the flexible, mobile needs of their students (Awadhiya & Miglani, 2016) and deliver richer, seamless learning experiences to those who want them (Chan et al., 2006). This is true for online and distance learning, yet there remains a paucity of research about how distance learners use mobile technologies. Reviews of the literature report that mobile learning research has too often been based on small sample sizes, involved early adopters and skewed to reporting positive results (Rushby, 2012; Wingkvist & Ericsson, 2009; Wu et al., 2012) and that just 10% of mobile learning research takes place in distance learning settings (Krull & Duart, 2017). The paucity of research into how distance learners use mobile devices needs addressing. More applied research is needed to move beyond consideration of user readiness or acceptance (e.g., Lam, Wong, Cheng, Ho, & Yuen, 2011) and towards use of mobile computing devices by teaching staff to teach, and of university students to learn (Gikas & Grant, 2013).

This paper responds to the need for research into distance learners' use of mobile technologies by seeking to problematise, map, and unpack the anywhere component of anytime-anywhere learning (Attewell & Savill-Smith, 2005). Using data from a survey of distance learners residing in the UK, this analysis is framed by the concept of seamless learning (Wong, Milrad & Specht, 2015) and Castells' theorisation of how physical space and online space interacts (Castells, 1997). Castells' conception of a dialectic between a *space of flows* and a *space of place* provides a guiding frame to situate the relationship between the virtual learning world—a global networked space of flows—and the bounded place in which the learner learns (Glassman & Burbridge, 2014; Martin & Madigan, 2006). When interpreted in the context of mobile learning, these concepts help foreground questions relating to the role that place and geographic mobility have on student learning and behaviour.

Distance learners represent a more mobile, more heterogenous, and more geographically dispersed group when compared to most campus-based student cohorts. For example, it is common for distance learners to be in full- or part-time employment and to have family or caring responsibilities thereby necessitating the use of multiple places for learning. Time is at a premium, and so understanding patterns of use to better support existing learning practices and find learners new opportunities to study—wherever and whenever this may be—is essential. At present, 12% of UK higher education students are enrolled in distance learning courses (Universities UK, 2016) with the Open University (OU) the largest distance learning provider. The curriculum is predominantly digital with teaching mostly taking place online using comprehensively-designed digital course materials and structured opportunities to interact with other students and tutors.

The focus of this paper is three key research questions relating to the places where learning by distance learning students occurs:

RQ1. Where and how are distance learning students using handheld devices for study and for non-study tasks?

RQ2. What is the relationship between the types of study-related learning tasks performed on handheld devices and the study spaces in which students use them?

RQ3. Are students experiencing a change in study habits and a positive impact on learning as a result of anywhere use of handheld devices?

This paper is structured in four sections. The first reviews the concept and challenges associated with anytime-anywhere learning, followed by a section describing the survey methodology and another presenting results. The concluding section discusses the research findings.

Towards Anywhere Seamless Learning

For over a decade, the concept of anytime-anywhere learning (Attewell & Savill-Smith, 2005) has been used in mobile and digital learning research to describe: how students access and learn from their course resources (Lowenthal, 2010), the patterns of interaction over time and space (Demsey, 2008), the opportunity for spontaneous learning in non-conventional situations (Vavoula & Sharples, 2009), and the potential for new pedagogies such as just-in-time learning or anywhere-anytime assessment (Nikou & Economides, 2017). Studies show that students value and notice these emerging potentials. For example, when asked what they liked best about using digital learning technology, 65% of students in a US study chose "mobility: I like being able to study anytime, anywhere" (p. 27) and 82% agreed that "I can spend more time studying because digital learning technology allows me to study anywhere" (p.28) (McGraw-Hill Education, 2016).

Mobile devices offer opportunities to students to commence and continue their learning across locations (Sharples, 2015; Wu et al., 2012), thereby allowing learners to "leverage mobile learning to facilitate holistic and perpetual learning experience that bridge different locations, times, technologies and social settings" (Chai, Wong & King, 2016, p. 170). Understanding the mobility of the learner, therefore, is associated with processes of meaning-making (Sharples, 2015), the weaving together of the formal and informal (Wrigglesworth & Harvor, 2017), and the interplay between physical and digital learning spaces (Chai, Wong & King, 2016).

Tablets, e-readers, and smartphones comprise three of the most common types of handheld device. The term handheld device is used in this paper in preference to mobile device (Brown & Mbati, 2015; Traxler, 2007) as it is a more objective description of the technology and avoids a presupposition that these devices travel between places. It is patterns of how students *make* handhelds mobile that this study seeks to examine.

Early research into the use of mobile devices often tended to focus on use for assimilative learning activities such as reading course content. This work identified a range of perceived benefits including convenience of access, portability, ease of finding resources, searching within documents, updating content, building personalised libraries, bookmarking, realising environmental benefits, incorporating interactivity, novelty, and ability to 'carry' more books (Jamali, Nicholas & Rowlands, 2009; Margolin, Driscoll, Toland, & Kegler, 2013; Wu et al., 2012).

As mobile handheld devices have become more capable, the range of learning activities that students can perform has increased. Students can now engage in collaborative and social learning activities such as personal publishing, starting conversations, joining social media, finding answers to questions from others, facilitating team collaboration, and knowledge sharing (Al-Emran, Elsherif, & Shaalan, 2016). Students can use productivity or media capture applications to assist in writing assignments, building portfolios, and taking notes, along with administrative tasks such as checking assessment scores, accessing timetables, and emailing tutors. Teachers' pedagogic options for using handheld devices have similarly increased (Brown & Mbati, 2015).

A range of limitations or challenges in use of handheld devices for learning have been identified including: form-factor and display quality, usability and navigation, no fixed page numbering, student preference for leisure rather than study-related use, and quality of teachers' knowledge and skills in using the technology (Cliatt, 2010; Dahlstrom, Brooks, Grajek, & Reeves, 2015). Consequently, print and electronic versions of a document may no longer be pedagogically equivalent (Bozkurt & Bozkaya, 2015) and even technologically savvy students may encounter significant challenges (Gikas & Grant, 2013).

Use of devices for both general leisure learning and study-related learning presents both challenges and opportunities for learners. Whilst potentially distracting leisure activities are merely a tap or swipe away, so are opportunities for informal learning. An ECAR survey found that 37% of undergraduate students admitted to being distracted from studying by social media and 35% by web surfing (Brooks, 2016). This finding is supported by open comment responses from Selwyn's (2016) survey of Australian undergraduates. Teachers in face-to-face contexts can regulate and control the learning space, yet in distance education it is mostly the learners themselves who face a constant state of negotiation with respect to establishing boundaries and deciding how to use the same device for both leisure and study activities.

Learners need support to understand how to manage their learning across locations and make positive adaptations to their study patterns and habits. Wong and Looi (2012) argue that utilisation of seemingly ubiquitous technologies is not a given, and a facilitated process of enculturation is required to help learners achieve a state of self-directed seamless learning. Situations where students move between formal and informal spaces may present additional challenges (Wong, King, & Chai, 2006). Furthermore, as Rushby (2012) notes, learner agency is sometimes limited in respect to where and when a handheld device can be used. The learning design here can be critical, working to either allow students to adapt designs to their mobility profile or close down and enforce specific sequences of learning tasks or study behaviours.

To understand how learners are responding to the emerging mobile learning opportunities opening to them, it is critical to understand the patterns, relationships, and transformations in use of study places. On the one hand, it may be that location and distance are becoming less relevant to the learner (Ally & Prieto-Blazquez, 2014). This may be of even greater relevance to distance learners because they study both at a distance from their university and, when mobile, at a distance from their home study space. On the other hand, perhaps context is becoming more important as the situated learner intentionally leverages the context and uniqueness of a particular place (Walker, 2006). Within the concept of anywhere learning therefore, there is a latent tension in respect to the theorisation of place wherein it is becoming both more ubiquitous (less relevant) and more unique (more relevant). It is these changing

patterns in course-related, formal learning with handheld devices that provide the focus of the three research questions examined by this study.

Method

Survey Instrument

The survey instrument used in this study represents the product of four years of iterative development and testing. In 2012, a university-sponsored programme of research into student use of handheld devices developed and piloted a version of the survey with a sample of 1,000 postgraduate students. Where practicable, questions were adapted from the ECAR survey in the US (Dahlstrom, de Boor, Grunwald, & Vockley, 2011), NetGen survey in the UK (Jones, Ramanau, Cross, & Healing, 2010), and USQ survey in Australia (Sankey, Tynan & McKeon, 2013). A total of 185 responses were received and analysed. Seven follow-up telephone interviews further probed student responses to the questions, verified the appropriateness of the language used in the question wording, and helped ensure content validity. A year later, the survey was iterated and sent to 3,000 undergraduate students; 525 responses were received (Cross, Sharples & Healing, 2015). A further iteration of the survey was administered to a sample of postgraduates and undergraduates in 2014 and received 754 responses. After each survey, questions that were judged by a panel of three experts to give poor validity or low discrimination across the response range were either removed or revised and re-tested. In addition, each survey instrument was reviewed by the university's Student Research Projects expert panel. Regular review of relevant literature helped identify necessary minor additions or revisions to question wording in response to changes in technologies, teaching approaches, and virtual learning environment (VLE) functionality.

This paper reports data from undergraduate students who were sent the 2016 iteration of the survey (Cross, Sharples & Healing, 2016). This included questions about: (a) ownership of technologies; (b) frequency of use of handheld devices (tablet, e-readers, and smartphones) for specified leisure activities and for specified learning activities; (c) locations at which each device is used for study purposes; (d) perceived change in study habits; (e) statements about impact of use on learning; (f) reason for purchase; (g) length of time used; (h) benefits and challenges; and (i) preferences for future use of each technology for learning. Open comment questions were added to probe the types of learning used in distance learning contexts, reasons for use or non-use, and the locations of use. Students were asked separately about their use of tablets, smartphones, and e-readers so potential differences in use could be analysed. Students were contacted by email in April 2016 and sent a reminder a few weeks later.

Three key constructs used in this paper relate to the number of study tasks, the study locations used, and whether or not students perceived their study habits to have changed. To ensure the survey instrument adequately captured these data, respondents in all three surveys were given the opportunity to write in what other types of study tasks they performed, what other study locations they used (in addition to those specifically asked in the survey), and about the extent and nature of changes to their study habits. Along with two further open comment questions, these data were interrogated and triangulated to ensure the three questions did not fail to capture a representative range of study tasks and locations. Responses to the binary (yes-no) question about change in study habits were also

compared to the follow-up open comment question that invited respondents to describe the nature of the change, or lack of it.

The focus of this paper is on the quantitative data collected by the survey. Details of the specific questions analysed are described in the Results section. Open comment data was also reviewed during the initial phase of analysis but will be analysed in detail elsewhere.

Sampling and Responses

A stratified sample of 3,000 undergraduate distance learners at the OU in 2016 were invited to answer an online questionnaire survey about their use of mobile handheld devices for learning. The sample was selected to ensure proportionate representation in respect to gender, subject of study, study level, and age. There were 446 responses giving a response rate of 14.9%. This compares favourably to similar surveys such as the 7% response rate for the US-based ECAR survey (Brooks, 2016) and 10.3–13.2% response rate for the Pew Research telephone survey (Rainie & Smith, 2013).

All age categories were well represented in the 2016 survey responses. 19.3% of respondents were 25 or under, 15.5% were 26–35 years old, 26.2% were 36–45, 17.7% were 46–55, and 21.3% were 56 or older. There was also good representation from learners studying first-, second-, and third-year level modules (26.9%, 35.2%, and 37.9%, respectively) and across disciplines: (a) 39.0% of respondents were from Arts, Humanities, and Social Sciences; (b) 37.9% from Mathematics, Science, or Technology; (c) 16.6% from Education, Health, and Languages; and (d) the remaining 6.6% from Business and Law. Students from each UK region served by the university were included. 61.4% were female and 38.6% were male.

Overall, the responses received are considered broadly representative of those contacted, apart from a slight over-representation in responses from older age groups. The response demographic is similar to that of earlier versions of the survey. The dataset was anonymised and loaded into SPSS for cleaning and analysis.

Results

RQ1. Patterns of Handheld Device Use for Study- and Non-Study Related Tasks

This section examines patterns of use of handheld devices by distance learners in the UK. In 2016, the majority of distance learners who responded had access to smartphones, tablet computers, and laptop computers (see Table 1). Access to tablet and smartphone devices was highest among the 26–35 years old age group and lowest among those over 56 years old. In respect to e-readers, the pattern is reversed with highest access among those over 56 years old and lowest among those under 25 years old. Results show that OU student access of tablets in 2016 is similar to that found in the US ECAR survey (57% ownership) (Brooks, 2016) but is higher than the 41% reported for the UK higher education sector by Newman and Beetham (2017).

Table 1

Undergraduate Access to Technology

	Age					Gender	
	Under 25	26–35	36–45	46–55	56 and over	Male	Female
Desktop computer	26%	43%	47%	42%	51%	52%	36%
Laptop	71%	68%	71%	73%	73%	66%	71%
Smartphone	86%	90%	85%	70%	64%	76%	73%
Tablet computer	53%	68%	59%	63%	57%	60%	58%
e-Reader	22%	23%	23%	27%	35%	25%	25%

Students were asked in which of seven location categories they had used their smartphone, tablet, and e-reader for study purposes in the last year. The item labels were: (a) home study room or other quiet room at home; (b) living room or other communal room at home, (c) at a workplace; (d) whilst travelling (e.g., by public or private transport) or walking; (e) café/pub/restaurant; (f) library; and (g) on holiday. For the purposes of this study these *study places* are described as: home private, home public, workplace, travelling, public communal, public quiet, and on holiday. Previous research tended to focus on a more limited range of locations (e.g., Wong, King, Chai, & Liu, 2016) so student responses to previous studies were important to category definition. Open comments in these surveys showed that students perceived a distinction between use in private and communal home spaces, and that many regarded holiday place as a distinct study place—one associated with non-regular, different, or unfamiliar locations for the primary purpose of breaking routine for a limited duration of time. Question piloting (n=6) determined the seven place descriptions provided a good range of locations and caused no confusion.

Survey results show variations in the use of handheld devices for study-related purposes between study places (Figure 1). Tablets are the device most commonly used at home, smartphones are more commonly used whilst travelling and in public communal places, and the use of tablets and smartphones are similar when on holiday, at work, and in public quiet places.

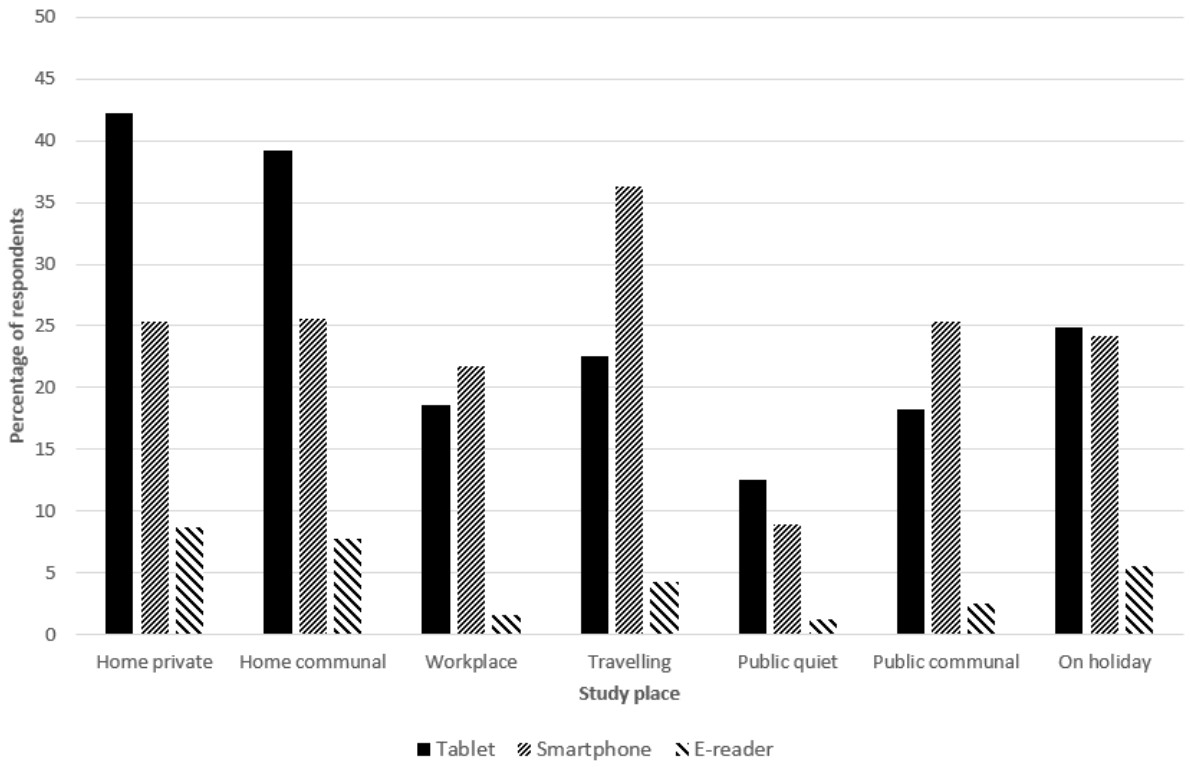

Figure 1. Student use of handheld devices in seven types of study place (*n*=446).

Of those students using a handheld device for studying, most use a single device in any one study place (Figure 2). Around 10–15% of students use two devices and 3–4% use all three (tablet, smartphone, and e-reader). Over half of all students (52.9%) used a handheld device for study-related purposes in home private spaces whilst just under half used at least one in a communal home place (49.8%) and whilst travelling (47.1%). Around the same proportion use handheld devices when on holiday and when at work.

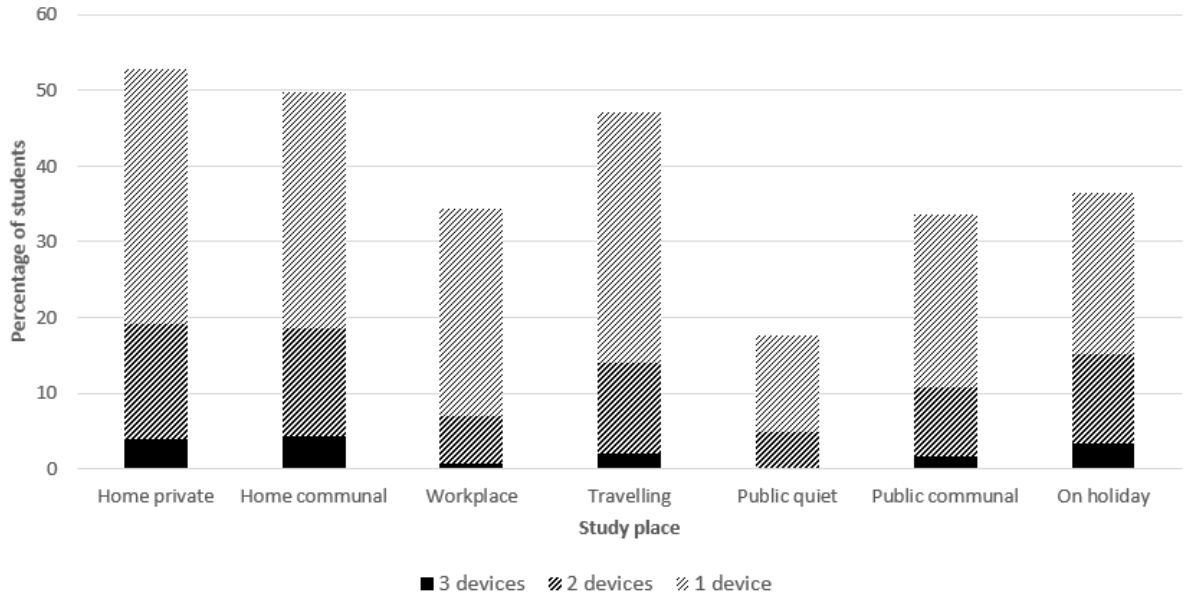

Figure 2. Percentage of handheld devices used (*n*=446).

Student use of handheld devices for 11 key study-related learning tasks is shown in Table 2. Nine of the 11 items map to learning activities described by other authors such as Wrigglesworth and Harvor (2017) and Al-Emran, Elsherif, and Shaalan (2016). The remaining two—use in assessment writing and exam revision—represent key stages of learning sometimes overlooked in other studies. These 11 items were mapped against a sub-set of the OU's learning activity categories (Conole, 2013) and represent a range of learning activity. Table 2 also reports the proportion of students using handheld devices to perform 12 non-study tasks—general or leisure tasks not directly related to study. These items were developed with reference to the ECAR survey (Brooks, 2016). Some study-related and non-study task items relate to similar types of activity such as reading digitally, using social media, or using video-conferencing technology.

Table 2

Proportion of Students Using Handheld Devices for Study-Related Learning Tasks and the Proportion Using Handheld Devices for Non-Study Tasks (n=446)

Type of learning activity	Study-related use of handheld devices		Non-study (i.e. general) use of handheld devices	
	Study-related task	%	Non-study task	%
Assimilative	(1) Reading module Materials	57.6	(1) Reading books	61.7
	(2) Watching module Materials	44.6	(2) Watching TV and film	59.4
	(3) Reading non-module study materials	52.0	(3) Listening to music or radio	69.3
	(4) Using social media	30.0	(4) Using social media	72.4
Communicative	(5) Using forums*	46.4	(5) Social networking	71.1
	(6) Online tutorial attendance**	16.1	(6) Video or audio calls	58.1
	(7) Using email	57.0		
Information handling	(8) Internet searching	37.4	(7) Reference	75.8
	(9) Revision for an Assessment	34.5	(8) News, sport and weather	81.4
			(9) Shopping or making bookings	74.9
Productive	(10) Notetaking	28.0	(10) Using productivity apps	59.2
	(11) Writing assessments	26.2	(11) Photography	78.5
Experiential	-		(12) Playing games online or offline	53.8

* Forums comprise a key social site for students to exchange views and network
** Online tutorials use synchronous video conferencing software

In 2016, over half of students were using handheld devices to read core study (module) materials, read other study-related materials, and email for study-related purposes (Table 2). Around a third used their device for exam revision, study-related Internet searching, and social media. Although the study-related and non-study tasks should not be considered equivalent, the data does appear to show that more students use their handheld devices for the latter (Table 2). For some types of tasks (e.g., reading digital content) the difference is slight, yet for other types of tasks (e.g., social media) the difference is greater.

RQ2. The Relationship Between Study-Related Learning Tasks and the Places Used for Study

The concept of flow between and across place is central to both Castells' conceptualisation of the space of flows and to that of anywhere and seamless learning. This provides the focus for RQ2. As described above, students were asked which of 11 types of learning tasks they performed on handheld devices whilst present in seven types of study place.

Four new variables were created from the survey data to help explore the relationship between what and where students are learning:

- Number of study places—indicates how many of the seven study places were used by the student to perform study-related learning tasks on a handheld device. This gives an indication of the geographic learning range of use on a scale of 0 to 7.
- Number of study tasks—indicates how many of 11 study-related learning tasks (see Table 2) were performed by the student using their handheld device. This gives an indication of the extent of learning taking place on handheld devices and has a scale of 0 to 11.
- Number of general tasks—indicates how many non-learning tasks (see Table 2) were performed by the student on a handheld device and has a scale of 0 to 12.
- Handhelds owned—indicates whether the student owned or had access to a tablet, smartphone, and/or e-reader. Measured on a scale of 1 to 3.

For students using handheld devices for learning (at least one learning task) (n=294), the relationships among study places, learning tasks, general tasks, and handhelds owned were investigated using Spearman Rho correlation coefficients. The results are shown in Table 3.

Table 3

Correlation Matrix for Students Using Handheld Devices for Learning (n=294)

		Correlations			
		1	2	3	4
(1)	Number of study places	1			
(2)	Number of study tasks	.472**	1		
(3)	Number of general tasks	.265**	.299**	1	
(4)	Handhelds owned	.131*	.037	.259**	1

*p < .05. **p < .01

A moderately strong statistically significant correlation of r_s=.472 was found between study places and study tasks (Table 3). The greater the number of study places a student learns in, the greater the variety of study-related learning tasks they undertake. This provides evidence for a strong correlation between the flow of use between places—the geographic mobility of students—and the range of their learning engagement via handheld devices.

The correlation between study places and general (non-study) tasks was also statistically significant, although weaker than that between study places and study tasks. The correlation between study tasks and general tasks was also of moderate significance. Whilst there was a statistically significant moderate

correlation between handhelds owned and general tasks, the correlation between handhelds owned and study tasks was weak.

Ownership of specific handheld devices can vary by age and gender (e.g., Table 1; Chen, Seilhamer, Bennett, & Bauer, 2015) but does this impact on overall use for learning? A one-way ANOVA shows no significant effect for age groups in respect to number of study places ($F(4,394) = .876$, $p=.478$) or number of study tasks ($F(4,394) = .334$, $p=.855$). Independent-samples t-tests show no significant effect with respect to gender on number of study places ($t(397) = .952$, $p=.341$) or number of study tasks ($t(397) = -.482$, $p=.630$). These findings establish no significant variation in number of study places or study tasks with respect to age or gender.

The final table in this section reports the number of students using handheld devices to study in each of the seven places (Table 4). It also reports the percentage of students using a handheld in that place who used it for that study task. For example, 236 students used a handheld device in the private home space and of these 211, (89.4%) used it for reading course materials.

Table 4

Use of Handheld Devices for Study-Related Learning Tasks in Seven Study Places.

	Number of students using handheld devices to perform study-related tasks						
Study task	Home Private	Home Communal	Place of Work	Whilst Traveling	Public Communal	Public Private	On Holiday
(1) Reading module materials	211 (89.4%)	202 (91.0%)	143 (93.5%)	185 (88.1%)	139 (92.7%)	72 (91.1%)	146 (90.1%)
(2) Watching module materials	172 (72.9%)	163 (73.4%)	112 (73.2%)	146 (69.5%)	115 (76.7%)	63 (79.7%)	124 (76.5%)
(3) Reading non-module materials	195 (82.6%)	191 (86.0%)	131 (85.6%)	171 (81.4%)	132 (88.0%)	68 (86.1%)	137 (84.6%)
(4) Using social media	118 (50.0%)	113 (50.9%)	81 (52.9%)	100 (47.6%)	86 (57.3%)	48 (60.8%)	80 (49.4%)
(5) Using forums	174 (73.7%)	168 (75.7%)	119 (77.8%)	145 (69.0%)	114 (76.0%)	63 (79.7%)	116 (71.6%)
(6) Online tutorial attendance	63 (26.7%)	62 (27.9%)	50 (32.7%)	53 (25.2%)	49 (32.7%)	33 (41.8%)	47 (29.0%)
(7) Using email	205 (86.9%)	196 (88.3%)	136 (88.9%)	181 (85.2%)	135 (90.0%)	69 (87.3%)	141 (87.0%)

(8) Study-related Internet searching	145 (61.4%)	141 (63.5%)	97 (63.4%)	124 (59.0%)	105 (70.0%)	57 (72.5%)	103 (63.6%)
(9) Revision for assessment	138 (58.5%)	133 (59.9%)	91 (59.5%)	119 (56.7%)	99 (66.0%)	55 (69.6%)	105 (64.8%)
(10) Note-taking	113 (47.9%)	102 (45.9%)	77 (50.3%)	94 (44.8%)	81 (54.0%)	52 (43.7%)	83 (51.2%)
(11) Writing for assessment	107 (45.3%)	101 (45.5%)	74 (48.4%)	88 (41.9%)	75 (50.0%)	47 (59.5%)	113 (51.9%)
Total using device in study place	236	222	153	210	150	79	162

Note. Percentages expressed as a proportion of all students who used their devices (for whatever purpose) in that study space.

Comparison of the distributions of tasks performed in each study place shows a similarity in pattern across the seven places. A chi-square analysis shows that there is no statistically significant difference between the pattern of study task performed across the seven study places ($X^2(60) = 26.041$, $p<.01$).

RQ3. Changing Behaviours and Impacts on Learning

The final section of the analysis investigates whether use of handheld devices for study-related learning is having an impact on study habits, access to materials, and the quality of students' work.

Two in five students said that their study habits had changed since starting to use handheld devices for study-related learning tasks (40.0%, *n*=119). Table 5 shows the mean number of study places used by those who experienced a change in study habit and those who did not. Independent-samples t-tests were used to determine whether study behaviours differed between the student group reporting a change in study habits and the group that did not. Visual inspection of Q-Q plot confirmed the data distributions were acceptable for this test. Test results (Table 5) show a statistically significant difference with respect to both the number of study places used and number of study tasks performed. Students reporting a change in study habits used their devices to learn in more study places and for more types of study tasks than those reporting no change in habit.

Table 5

t-Test Results Comparing Students Reporting a Change in Study Habits and Those Who Did Not (n=297)

	No change in study habits		Changed study habits			
	M	*SD*	*M*	*SD*	t-test	*p*
Number of study places	3.57	2.01	4.85	1.72	5.70	<.001
Number of study tasks	5.47	3.31	7.53	2.82	5.57	<.001

Note. SD = standard deviation; M = mean.

Students were also asked whether using handheld devices for study had made it easier to access module materials and had improved the quality of their work. Whilst most students using handheld devices found it easier to access module materials, less than a third believed that such use had improved the quality of their work (Table 6).

Table 6

Student View About Impact of Handheld Device Use on Learning

	Definitely disagree (1)	Mostly disagree (2)	Neither agree nor disagree (3)	Mostly agree (4)	Definitely agree (5)	*M*	*SD*
(a) Using handheld devices made it easier for me to access module material	21 (7.3%)	24 (8.4%)	57 (19.9%)	79 (27.6%)	105 (36.7%)	3.78	1.23
(b) Using handheld devices has improved the quality of my work	34 (11.8%)	39 (13.6%)	130 (45.3%)	43 (15.0%)	41 (14.4%)	3.06	1.15

Note. SD = standard deviation.

Multiple regression analysis was used to determine whether the key variables used earlier in analysis were predictors of easier access to materials and improved quality of work. The results are shown in Table 7. The models predict 32.7% and 34.3% of the variance, respectively, and overall show a good fit to the model. Checks for collinearity and normal distribution of residuals were found to be satisfactory. Number of study tasks, number of study places, and a change in study habits are predictors in both models. The beta for age is negative, showing that younger students are more likely to report improved quality of their work than are older students.

Table 7

Summary of Regression Analysis (n=287)

	Easier to access module materials			Improved quality of work		
	B	*S.E. B*	*Beta*	*B*	*S.E. B*	*Beta*
Number of study tasks	.077	.021	.210**	.102	.023	.262**
Number of study places	.079	.034	.132*	.096	.036	.151**
Number of general tasks	.059	.030	.109*	.017	.031	.029
Change in study habits	.797	.120	.341**	.821	.127	.329**
Age	-.007	.004	-.085	-.010	.005	-.114*
Gender†	-.081	.117	-.034	.144	.124	.057
R^2	.327			.343		
F	24.189**			25.834**		

*p < .05. **p < .01.
†Gender coded: 1=Male, 2=Female

Discussion and Conclusion

This study has investigated where students study and how use of study places affects their mobile learning activity and habits. The research questions focus on aspects of anywhere learning—one of the two key terms in the concept of anytime-anywhere learning—such as how students move between places and translate the *potential* of anywhere into the practical somewhere. The dataset used comprises 446 responses from an online survey of undergraduate distance learners in the UK. Too narrow a focus on one group of learners can be problematic (Al-Emran, Elsherif, & Shaalan, 2017) so the sample included adult learners in all age groups and major discipline areas.

In respect to RQ1, it was found that by 2016, over half of learners were using handheld devices for study-related purposes. This represents a doubling in device use over three years since 2013 (Cross, Sharples & Healing, 2015). However, use for learning still appears to be less than use for leisure tasks.

Two key findings relate to RQ2. Firstly, the distribution or pattern of study-related tasks was similar amongst the seven study places investigated. For any of the 11 study tasks investigated, students do not appear to favour one type of study place over another. Of course, the learning achieved by performing any given task in different places may not be pedagogically equivalent (Wong, King, Chai, & Liu, 2016) and such patterns of use therefore require further qualitative study. Secondly, analysis confirms a strong and significant correlation between the number of study places used for handheld learning (what could be considered a student's geographic reach) and the number of different learning tasks performed on handheld devices (a measure of breadth of learning). As the number of study places increases, so too does the number of different learning tasks performed. These findings underscore the importance of helping students to maximise learning opportunity time; for example, by developing a learning design that can flex and allow mixing of learning tasks and technologies across locations.

The final research question (RQ3) explored the impact of handheld use on study habits and quality of learning. There were two key findings. Firstly, analysis shows that three variables—number of study places, number of study tasks performed, and change in study habits—are predicators of students finding it easier to access learning materials and reporting improved quality of work (r_s^2=.327 and r_s^2=.343, respectively). 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. This finding seems consistent with observations from studies of campus-based students where approximately half said that using handheld devices helped them to find more time or save time (Gebb & Young, 2014; Rainie & Smith, 2013).

The second finding relating to RQ3 is that student experience of, and derived benefit from, using handheld devices for learning varies substantially. A majority of students said that handheld devices had made it easier to access study materials and 40% had experienced a change in study habits since starting to use handheld devices for study-related learning. However, this means that only a third of students felt that use of mobile handheld technologies had helped improve the quality of their work and 60% had yet to change their study habits. These data, therefore, illustrate how using mobile technologies to extend the geographic and temporal range of the potential learning space can mean a transformation in study habits for some whilst allowing others to maintain existing study behaviours. There may still be some way to go in ensuring all learners benefit from the mobile pedagogies deployed. Staff competency and skills (Dahlstrom et al., 2015) may be one limiting factor, as could student perceptions about the value and opportunities for use as well as decisions about when, or even if, they

want to use handheld devices for learning. It is recommended that further qualitative investigation would help understand how students interpret the concepts of quality and habit in the context of mobile learning, and how positive perceptions that use benefits learning might map to student narratives relating to academic success (e.g., Brooks, 2016).

Taken together, these findings establish a link between the number of study places used for learning and the breadth of learning activity. In so doing, this study not only evidences a link between what Castells (1997) described as the space of place and the space of flows but also asks whether additional components need to be added to this concept of flow. Two additional concepts are proposed. The first is that the movement of learners between and through study locations could be viewed as a *flow of places*. This should look beyond the question of how the virtual and real are woven together (Traxler, 2010) and ask how learning flows between places, how students' perceptions of a place change once it becomes adopted as a learning place, and how such new perceptions materially transform that place. Certainly, for many learners, handheld devices have extended the range and reach of their physical study place, the opportunity time for learning, and potentially the range of digital learning activity.

The second concept relates to the constant negotiation students enter into in respect to the *place of space*—how they exert their agency as learners, and when and to what degree they grant this virtual place access to the real places in which they study. In particular, consider the subset of students who seldom, if at all, use handheld devices for study-related learning. It is this group for whom participation in Castells' space of flows is limited or even non-existent. Wriggleworth and Harvor (2017) argue that the level of engagement depends on student awareness of potential learning benefits and their disposition with respect to actively seeking out opportunities to learn with their mobile device. Further, anecdotal evidence from survey open comments shows many students are making conscious decisions to restrict or abstain from using handheld devices for learning. Whether justified or not, students are taking a view about the place that an online digital space should have in their learning.

This paper has explored relationships among learning activities, study habits, and the locations of learning. The two new concepts outlined above—the *flow of places* and *place of space*—provide further avenues for mobile learning research that complement those developed by Castells and the approach adopted by proponents of seamless learning. How do students negotiate emerging spatial opportunity—the place of space—in their digital and online learning? What are the patterns, dynamics, and disruptions in how students move between places? Do patterns vary between groups, such as those with disabilities? Understanding more about the use, and non-use, of handheld devices will help teachers and learning designers develop more effective and flexible pedagogies for the support of anywhere learning.

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