CETL4 Health NE
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PDA devices and electronic resources to support learning in clinical placements and education settings

Lesley Scott and Fiona Curtis

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i. Executive Summary

Introduction

- Across healthcare pre-registration training increasingly more students are spending more time (on placements) at locations which are distant from the main university site where access to traditional resources can be limited.
- As part of the CETL4HealthNE capital expenditure money was invested in Personal Digital Assistants (PDAs) and Dr Companion SD cards. It was seen as an opportunity to try to support student learning across both Higher Education and placements within the NHS for multiple professional groups.
- This report provides multiple perspectives on the use of resources on mobile devices to support learning and decision making.

Objectives

- To pilot the use of the Companion Compendium with PDAs among pre-registration healthcare students (medical, nursing and pharmacy students, with the resource being customised for the latter groups).
- To investigate and compare reported use in academic and practice settings in order to gain an understanding of how and when the devices and resources were used to support learning and decision making.
- To gather staff and student perspectives on the usefulness of the PDA and resources, and ways in which the resources were used in other institutions.
- To assess the practicality and sustainability of using these resources.

Data Collection

- Students were asked to complete an on-line questionnaire.
- Semi-structured interviews were arranged with academic and clinical staff supporting the students on the pilots.
- Semi-structured interviews were arranged with staff at two other HEIs, which were using Dr Companion.
- Data was analysed thematically by two researchers.

Findings

Companion Resources

- Companion Resources were used in differing proportions by the different groups of students, depending on their stage in their degree and the specific placement they were on.
- All pilots had the BNF and, out of the available resources in the compendium, this proved to be the most popular.
- Companion resources included a medical dictionary; either the Oxford Concise Medical Dictionary or Steadman's Medical Dictionary. They were frequently used for looking up definitions.
- Each Companion compendium contained an anatomical resource; either Instant Pictorial Anatomy or Netter Atlas of Human Anatomy. These received mixed comments from students, with some finding them useful, particularly for revising and

in clinical settings, whilst others struggled with both the technology and the resources.

- A range of Oxford Handbooks were provided on the Companion chips, dependent on the cohort of students, and in some cases they proved popular.

Context of how the PDA and Companion Compendium were used to support learning

- The PDA and Companion compendium resources were used to support mobile learning, learning in practice/clinical encounters and taught sessions, self-directed learning and revision.
- Student feedback indicated that they valued both the immediacy and accessibility of resources on a mobile device.

Factors influencing use of technology

- A range of factors influencing how the students used the PDA and companion resources emerged including: personal circumstances and preferences, acceptance in the clinical/placement setting, stage of training and embeddedness in the curriculum, cost, training, familiarity, hardware and software issues and time pressure.

Recommendations

- It is essential that the use of technology is part of a blended approach within teaching and learning and is not just added on as "something that should be done".
- Successful integration of mobile technology into the curriculum needs to be embedded as a core part of how the students are both taught and how they support themselves as learners.
- Engagement with Faculty is crucial to ensure acceptance and appropriate role modelling of use, and understanding of how mobile technology and associated resources can support learning, particularly in the clinical setting and can be embedded into the curriculum.
- Providing PDAs is not economically sustainable in today's financial climate particularly with the speed and change of technology and as many students have access to their own smartphones.
- Guidance should be provided to students as to how they can use the technology that they have to support their learning, including data protection and patient confidentiality and minimising contamination.
- Where on-line/electronic resources are to be mainstreamed, alternative hardware must be considered for students who might not own mobile devices.
- Faculty should consider ways of providing pointers to on-line resources and accessible resources through their University Library that may have no, or little, cost implications; this may be more appropriate than purchasing a Companion Compendium.
- If additional resources, such as the Companion Compendium, are to be provided/recommended to students, then careful consideration of which resources are provided/recommended and how they link in to the level of study is required.
- Provision of Wi-Fi internet access in clinical placements is essential to make the most use of mobile devices, especially if they will be used for workplace-based assessment or for portfolios.

Conclusion

- Technology advances rapidly, and although there is much guidance in the literature regarding considerations when purchasing hardware for use by students to support learning, we conclude that such purchases of PDAs are now outmoded as these have now been replaced by smartphones and tablets.
- Many of the factors influencing use were related to the PDA with regard to usability, portability, battery life, screen resolution and size and other PDA properties and linked to student circumstances such as disability, technophobia, familiarity, and preferences, e.g. reading on screen, and these ultimately affected how the students engaged with the PDA and Companion compendium resources.
- There are a number of considerations when contemplating the use of mobile technologies to enhance and support the learning of health care students and practitioners. A revised list of questions as suggested by George and Davidson (2005) for institutions considering how to incorporate mobile learning into the curriculum should be:

    - What are the best software programs for mobile technology to support student learning?
    - Can students replace required textbooks with mobile software and applications?
    - What is the best way to integrate mobile technology use among the faculty?

- This pilot allowed us to trial the use of PDAs across a number of pre-registration healthcare programmes, but in terms of sustainability, this would not be sustainable for the numbers within the programmes and also the technological support requirements.
- In order for such technology to be supported and rolled out over a whole programme it is essential such resources are embedded and valued by both Faculty and students.
- The main benefits that the students perceived about the use of the PDAs and the Companion compendium was around the portability of the devices (access anywhere anytime) and how they could make better use of quiet times in the placement setting to consolidate learning, i.e. the immediacy of access.
- The resources proved to be very useful to the students, many of whom didn't want to return the device and resource and others who expressed that they were considering purchasing the Dr Companion once qualified. Students perceived that the easy access helped facilitate learning and ultimately improve their performance in the clinical setting.

ii. List of Abbreviations

BNF	British National Formulary
CETL4HealthNE	Centre for Excellence in Professional Healthcare Education
HEFCE	Higher Education Funding Council for England
HEI	Higher Education Institution
LRM	Learning Resource Manager
NHS	National Health Service
PDA	Personal Digital Assistant
SD	Secure Digital
SHA	Strategic Health Authority
SIFT	Service Increment for Teaching
TEL	Technology Enhanced Learning

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vi. Acknowledgements

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1. Background

1.1 CETL4HealthNE

The CETL4HealthNE is a collaboration of nine partners, including Higher Education institutions (Newcastle, Durham, Northumbria, Sunderland and Teesside universities) and NHS partners (NHS North East (SHA), North Tyneside Primary Care Trust, Northumbria Healthcare NHS Foundation Trust and North Tees & Hartlepool NHS Foundation Trust). The aim of the CETL4HealthNE has been to help prepare future healthcare professionals better in order to meet the needs of a modernised NHS and the growing and changing expectations of its patients. This has been achieved by a strong collaboration of partners at both strategic and operational levels, with a shared interest in developing and embedding good practice in healthcare professional education in order to design and deliver innovative learning and teaching programmes across a range of healthcare professions (including doctors, dentists, nurses, therapists and pharmacists).

In its aim to foster curriculum development for employability, the CETL4HealthNE recognised health and social care students need to be prepared to fulfil the needs and expectations of the people accessing their services, ensuring that they are 'Fit for Purpose, Fit for Practice as well as Fit for Award'. From the Stage 2 bid which outlined how the CETL4HealthNE intended to achieve its outcomes, the learning environment was highlighted as an important dimension particularly for healthcare students who span two provisions: in higher education institutions (HEI) and in practice settings (NHS). Across healthcare pre-registration training increasingly more students are spending more time (on placements) at locations which are distant from the main university site; information and communications technologies need to be strategically exploited in order to support, facilitate and manage their learning. Learning technologies, in this case mobile devices, were seen as an opportunity to enhance the learning experience potentially in both settings, as well as the home environment.

1.2 Mobile Learning for Students

In the Stage 2 bid to the Higher Education Funding Council for England (HEFCE), it was envisaged that in order to build learning around experience, in a range of contexts from the classroom to the bedside, innovation had to be linked closely with learning technologies. As part of the Cetl4HealthNE capital expenditure a number of Personal Digital Assistants (PDAs) and Dr Companion Secure Digital (SD) cards (hereafter called Companion Compendium) were purchased and used in a variety of settings across the collaboration. Companion compendium SD cards store a collection of clinical reference texts and resources such as the British National Formulary (BNF), the Oxford Handbook of Clinical Medicine and many others; the cards were supplied by Medhand International (http://medhand.com/). The PDAs were purchased in March 2007; ACER N300 PDAs were chosen for their screen size which at the time was larger than most, whilst still being compact. At the time, 205 ACER PDAs were purchased and 250 Companion compendium licences with resources on SD cards were purchased; within an earlier phase of the capital expenditure 45 Hewlett Packard PDAs were purchased for a separate study (Cotterill *et al.*, 2008) and it was envisaged that the Companion compendium SD cards could also be utilised in these older PDAs. The licence allowed access to the electronic resources for one year. Through negotiations with

Medhand International (suppliers of the software) the licence was subsequently extended and also customised.

Although all partners had indicated a wish to participate in trialling these resources, it proved difficult to identify suitable student groups able to trial the devices and the software. The main issue was that in each professional grouping, there were more students than the number of devices and Companion compendia that were available, thus creating an issue regarding equity of access. So, for example, if we were considering rolling out the resources to medical students within a year group, then they all had to be offered the opportunity to participate. Therefore, where possible, discrete cohorts were identified who could have access to the resources without there being an issue with equity. For some of the pilots, for example the Newcastle University medical student pilot, it was offered to all students who self-selected to participate – this was approved by the Board of Studies at Newcastle University. There was also an issue of how appropriate the resources were to the stage in the curriculum the students were at and thus whether they would benefit from them. Eventually, it was decided that a pilot would be run with medical, nursing and pharmacy students and the SD cards were customised by the supplying company (Medhand International) for each of these professional groups. This was the first time such a customisation had been carried out.

When purchased, the Companion compendium was a SD card based system which enabled students to access a wide variety of electronic medical resources (textbooks). The original licence included the ability to synchronise with the MedHand International website to receive any upgrades that were available to the texts. After consultation with Medhand International, the licence was extended at no extra cost until the end of January 2010, however, synchronisation was not possible and the cards were therefore issued as stand-alone resources with resource collections customised for pharmacy and nursing students. In the interim period, between the initial supply of SD cards and the re-issued SD cards, the DocTool search facility on the Companion compendium SD card had been upgraded. In the initial issue the DocTool search facility only searched each text individually, whereas the updated DocTool search facility searched all texts/collections on the SD card.

In the majority of cases where students were issued with PDAs and the Companion compendium SD card, supervisors both in the NHS and University were also issued with the same equipment and resource. In the case of the nursing students this was negotiated via the Practice Placement Facilitators and some nursing mentors had access to the resource. In the case of pharmacy students, placement supervisors also had their own copy of the resource. The only exception to this arrangement pertained to Newcastle University students on a 12 week rotation, in this case Board of Studies approval for the project was granted, clinical base units were informed of the students having access to the resource, but no resources were deployed to the staff in the base units.

1.3 PDA and Companion Compendium Pilots

The pilot included multiple projects across different professional groups and contexts, which included:

- *Durham University* medical students (2nd Year) Phase 1 Medicine – these devices and SD cards were used for two consecutive groups of students (2007 [n=55] and 2008 [n=47]) over two subsequent academic years.
- *Newcastle University* medical students (5th Year) who were trialling PDAs and e-portfolios at James Cook University Hospital whilst on their clinical attachment were issued with Companion compendium SD cards to be used in conjunction with the PDAs. These PDA's had been bought nearly two-years earlier for the e-portfolio trial as part of CETL4HealthNE[1] (2007 [n=45]).
- *Newcastle University* medical students (5th Year) at the start of their fifth year, whilst commencing on one of four rotations (child health, mental health, primary care or women's health) for 12 weeks (2008 [n=121]).
- *Teesside University* nursing students (3rd Year) on clinical placements at either North Tees and Hartlepool NHS Foundation Trust or at James Cook University Hospital during their clinical placement for 6 weeks (2009 [n=42]).
- *Sunderland University* pharmacy students (3rd Year) at the start of their placement which was either in a commercial pharmacy (COOP) or a NHS pharmacy (Northumbria Healthcare NHS Foundation Trust) (2009 [n=14]).

1.4 Deployment and Roll-out

For the various pilots all students self-selected to have access to these resources and for all the different pilots they were given hand-outs detailing the operation of the SD card and PDA as well as a helpline telephone number and email address for any support queries provided by CETL4HealthNE IT technicians. In addition to this, Durham University also provided additional support via a wiki and the Learning Resources Manager (LRM). In the majority of the pilots the students were given a one hour training session in the use of the PDA which covered how to access the resources, how to charge the devices and how to reset them if required. Training was also given in how to search across the different collections on the SD card. As the SD cards could also be used with laptop or desktop computers, instructions on how to remove the SD card from the PDA were also given so that it could be used in other devices. Standardised training materials were developed and used across the CETL4HealthNE pilots and these were shared with Durham University and vice versa.

1.5 Additional Engagement

In addition to student usage, the chips were also given to some NHS librarians based in a local hospital trust for them to access the resources and provide feedback on them. As previously mentioned, staff in the professional groupings were also given the opportunity to have the same hardware and software as the students in order that they could evaluate it,

[1] Cotterill, S. J., P. Horner, et al. (2008). PO2: Evaluating the use of hand-held computers by medical students to access e-Portfolios and clinical guidelines in a wireless environment. EPortfolios, identity and personalised learning in healthcare education, Newcastle upon Tyne, HE Academy MEDEV Subject Centre.

and to ensure that they understood that the students had an authentic reason to use the devices in practice settings.

Other higher education institutions have licensing agreements with Medhand International. In order to obtain a broader picture of how other institutions were using the software and hardware and how they had embedded it, additional interviews were carried out with two other institutions.

2. Literature review

2.1 Use within Health and Social Care Education

The literature around the use of handheld devices or personal digital assistants (PDAs) is vast and has evolved since their first usage in the early 1990s. Some of literature focuses on the use of PDAs and electronic portfolios (e-portfolios) and has not been included within the literature for this study as the focus is primarily on the use of PDAs supplied with electronic texts to support student learning in both practice and academic settings.

Many publications are focused around nursing and nurse practitioners mainly based in America, and the literature is mainly descriptive in nature (Goldsworthy *et al.*, 2006; Zurmehly, 2010) with a "low-level evidence" base (Leung and Johnston (2006, p. 353). Some of the publications focus more broadly on standard functions of PDAs, (the electronic organiser, note taking capabilities and voice recorder) as well as additional functions as optional extras (electronic textbooks, medication prescribing information, medication calculators) (De Groote and Doranski, 2004; DeHart *et al.*, 2004; Peterson, 2004; Stroud *et al.*, 2005; Walton *et al.*, 2005; Kho *et al.*, 2006; Brubaker *et al.*, 2009; Dasgupta *et al.*, 2009). In some cases this was an integral part of patient care and documentation (billing and coding) (Criswell and Parchman, 2002; Kho *et al.*, 2006). There is also evidence that PDAs are being used to support case-study and patient studies as part of the assessment process. However, Kuiper (2008, p. 90) felt that there was not much evidence of the PDAs' "effect on clinical reasoning in nursing students." However, Walton *et al.* (2005), as part of their study, carried out a literature review of articles post 2000 and both the advantages and disadvantages they identified from the papers were the same as were identified in the literature review for this study, although the literature in this case is up to 2011.

Honeybourne *et al.* (2006, p. 53) in their phase two part of the trial investigating "which hand-held resources were most useful in the clinical setting" trialled the beta version of the Dr Companion SD card which was not available on the open market. The Companion compendium SD card was supplied by Medhand International and the information sources on the SD card were either the same or very similar to those used with the CETL4HealthNE pilots. Further links with the findings will be picked up in the discussion.

2.2 PDA supports Learning and Clinical Practice

There are varying reports describing the effectiveness of PDAs and associated resources in supporting learning and clinical practice. DeHart *et al.* (2004, p. 4) found that "79.2% of students believed that PDAs had a positive impact on their learning". In the survey carried out by Stroud *et al.* (2005, p. 72) they found that "96% of respondents agreed that the PDA had supported their learning and/or clinical practice". Carlton *et al.* (2007, p. 257) reported that "73% of students felt that it increased their classroom and clinical productivity". However, Hudson and Buell (2011, p. 404) found that only "21% of students felt it enhanced their clinical learning/teaching environment". Stroud *et al.* (2005, p. 70) found that students reported that they had purchased a "PDA for assistance in clinical decision making" and Brubaker *et al.* (2009, p. 390) found that the "PDAs provided a bridge for students to connect theoretical learning to practice".

White *et al.* (2005, p. 150) claimed that the "software enhances learning by allowing the student to rapidly and efficiently access pertinent data while in the clinical setting." Stroud *et al.* (2005, p. 73) found that "PDAs were used primarily to support the application of current evidence, standards, and knowledge for clinical decision making" this finding is reinforced by Scordo (2003, p. 362) who found that "students use PDAs to track patient information and obtain information necessary to make safe, effective patient care decisions".

With regard to the use of PDAs in classroom settings, Torre and Wright (2003, p. 998) claimed that "educators have also described PDAs as an enhancement to teaching" whilst Zurmehly (2010, p. 180) saw the use of the PDA in the classroom setting as an opportunity to create "active learning opportunities for users to work with PDAs in the classroom … promoting their use as a problem-solving tool." From the student perspective, George *et al.* (2010, p. 374) found that 67% of students used the PDAs in the classroom setting and Hudson and Buell (2011, p. 403) reported that 32% of the students reported the PDA as being "useful in the classroom as a learning/reference tool". A literature review by Zurmehly (2010, p. 179) "supported the use of PDAs as an effective teaching-learning strategy."

2.3 Timeliness and Accuracy of Data

Many papers highlighted the value of PDAs in providing easy access to current and accurate electronic data sources; this is supported by Walton *et al.* (2005) and Zurmehly (2010). Many authors likened this to the expectation that healthcare professionals, and in particular pre-registration healthcare professionals, carry handbooks, practice guidelines etc. with them in order to support decision making in the clinical setting (Turner *et al.*, 2005; Goldsworthy *et al.*, 2006; Koeniger-Donohue, 2008). Kuiper (2008, p. 90) highlighted the complex nature of healthcare which "precludes reliance on memory as a sole resource for problem solving because it can be unreliable". Hence, it can be seen why some authors such as Koeniger-Donohue (2008, p. 74) referred to "PDAs as a "peripheral brain" because individuals can save time, decrease errors, and simplify information retrieval at the point of care", i.e. PDAs can support students/staff memory. Nevertheless, Kho *et al.* (2006, p. 535) view this potential dependence and reliance on a device as problematic, reporting that these students "do not retain as much information as students who rely more on their own memory".

PDAs are seen to allow speedier access to more up to date sources of information than paper-based systems (Stroud *et al.*, 2005; Carlton *et al.*, 2007; Kuiper, 2008). Brubaker *et al.* (2009, p. 390) found that students "reported that they were able to find information much faster with the PDAs than with traditional reference sources". This helped them with time management during their clinical day. As well as the information being more up to date than text books (Johnston *et al.*, 2004; Brubaker *et al.*, 2009), Koeniger-Donohue (2008, p. 76) highlighted that the students felt "not only did they save time, but they also spent more time with patients because it was not necessary to leave the patient's room to look up accurate and reliable information". George *et al.* (2010, p. 374) reported that they found that 96% of the students used the PDAs in a clinical setting and that the most common use appeared to be "as a reference tool, predominately at the point of care". Williams and Dittmer (2009) and Luanrattana *et al.* (2010) also found that students used the PDAs for

information retrieval at the bedside and Williams and Dittmer (2009, p. 224) reported that 91% of the students perceived that "currently practicing nurses should use e-books.

2.4 Usage and Advantages

From the literature, the most common texts and usage for the PDAs and reference materials were:

Drug reference[2]	(Doran, 2003; Armour, 2004; De Groote and Doranski, 2004; Walton *et al.*, 2005; Goldsworthy *et al.*, 2006; Honeybourne *et al.*, 2006; Kho *et al.*, 2006; Carlton *et al.*, 2007; Brubaker *et al.*, 2009; Williams and Dittmer, 2009; George *et al.*, 2010; Hudson and Buell, 2011)
Medical math/formula calculator	(Criswell and Parchman, 2002; Armour, 2004; Stroud *et al.*, 2005; Walton *et al.*, 2005; Honeybourne *et al.*, 2006; Kho *et al.*, 2006)
Cochrane Reviews	(Johnston *et al.*, 2004)
Medical Dictionary	(George *et al.*, 2010; Hudson and Buell, 2011)
Practice clinical guidelines	(Stroud *et al.*, 2005; Turner *et al.*, 2005; Honeybourne *et al.*, 2006; Kho *et al.*, 2006)
Iformation about new drugs and lab results	(Carlton *et al.*, 2007; Williams and Dittmer, 2009)

Table 1: Most common texts and usage for PDAs and reference materials from the literature

2.5 PDA as a tool to support Patient Safety and Patients

There were no explicit examples of the use of PDAs when used as an electronic resource resulting in improved patient safety. However given the volume of literature indicating that the most frequently used resources were linked to prescribing, the implicit expectation, is that in clinical settings, PDAs could contribute to a reduction in medication prescribing errors (Stroud *et al.*, 2005; Walton *et al.*, 2005; White *et al.*, 2005; Goldsworthy *et al.*, 2006; Honeybourne *et al.*, 2006; Zurmehly, 2010). Hudson and Buell (2011, p. 405) felt that in their study the "near access of a reliable reference assists with the avoidance of adverse events" and Armour (2004) found that several studies linked usage to a positive impact on patient outcomes and a reduction in errors. In some cases, students used the PDA to help as an educational tool with patients (Armour, 2004; Honeybourne *et al.*, 2006; Koeniger-Donohue, 2008).

2.6 PDA Training and access to device (length of time)

Training in the use of the PDAs for utilisation with both staff and students varied across the published studies. The range of training across the studies varied from one 45 minute training session (Hudson and Buell, 2011) to two 60 minute training sessions (Goldsworthy *et al.*, 2006). The amount of training or familiarisation time with the PDAs was seen to be important (Kho *et al.*, 2006) and linked in to initial usage of the devices. In some of the studies students had to purchase their own PDAs. Consequently these students who had

[2] Johnston et al (2004) reported that Prescribing/drug information "deemed least useful" which is contradictory to all the other papers.

purchased their own devices, had already familiarised themselves with the device to some extent prior to the training session (White *et al.*, 2005).

The length of time that students had access to PDAs ranged from a minimum of 8 weeks (Johnston *et al.*, 2004), to 3 months (Honeybourne *et al.*, 2006) to a year (DeHart *et al.*, 2004) or longer when the PDA was purchased as a core requirement of a course (Carlton *et al.*, 2007). In one case, as a result of a pilot which was perceived as successful, the next cohort then had to purchase their own devices (White *et al.*, 2005; Koeniger-Donohue, 2008; Williams and Dittmer, 2009). In some cases there was no pilot and it was compulsory for students to purchase a PDA for a particular course/programme (Stroud *et al.*, 2005; Carlton *et al.*, 2007). This was seen as a concern in some cases as it became an added expense for students (Zurmehly, 2010).

2.7 Issues relating to using PDAs and accessing resources

From the literature, the most common issues and problems experienced were:

Confidentiality and data protection (security) in the clinical setting relating to the potential for recording of patient information and patient confidentiality	(Torre and Wright, 2003; Peterson, 2004; Turner *et al.*, 2005; Walton *et al.*, 2005; Goldsworthy *et al.*, 2006; Davies, 2007; Zurmehly, 2010)
Wireless – connectivity to hospital networks – in many cases in clinical settings the PDAs could not be connected to wireless networks	(Goldsworthy *et al.*, 2006; Zurmehly, 2010)
Battery life - including forgetting to charge the battery and battery drainage	(Johnston *et al.*, 2004; Turner *et al.*, 2005; Walton *et al.*, 2005; Taylor *et al.*, 2006; Carlton *et al.*, 2007; Davies, 2007; Brubaker *et al.*, 2009; Zurmehly, 2010)
Technological support – this includes levels of support and demands on staff and perceived lack of support.	(Walton *et al.*, 2005; Honeybourne *et al.*, 2006; Carlton *et al.*, 2007; Brubaker *et al.*, 2009; George *et al.*, 2010; Zurmehly, 2010)
Loss or damage to PDA – concerns by students about damaging the device and therefore reluctant to use it.	(Torre *et al.*, 2003; Turner *et al.*, 2005; Zurmehly, 2010)
Unexplained freezes requiring hard resets	(Carlton *et al.*, 2007; Zurmehly, 2010)
Cost: this includes general costs, when compulsory for a student to purchase and potential costs of medical and nursing software	(Armour, 2004; Walton *et al.*, 2005; Leung and Johnston, 2006; Carlton *et al.*, 2007; Koeniger-Donohue, 2008; George *et al.*, 2010)
Usability issues including screen size and scrolling etc	(Scordo, 2003; George and Davidson, 2005; Miller *et al.*, 2005; Goldsworthy *et al.*, 2006; Kho *et al.*, 2006; Zurmehly, 2010)
Staff/faculty attitudes as barriers to utilisation	(Johnston *et al.*, 2004; White *et al.*, 2005)
Comfort level of technology for both staff and students	(Johnston *et al.*, 2004; Stroud *et al.*, 2005; George *et al.*, 2010; Zurmehly, 2010)

Table 2: Most common issues and problems experienced with PDAs from the literature

2.8 Reliance on Technology and technological change

Peterson (2004, p. 55) predicted more reliance on technology by clinicians, claiming that "as the technology develops, the PDA will become as much a part of the clinician's armoury as

the stethoscope". This is supported by Honeybourne *et al.* (2006, p. 59) who found participants in their study felt that the technology was "emerging as an effective clinical tool to aid evidence-based practice and support the educational needs of clinical staff".

Doran (2003, p. 122) foresaw that "increased mobile phone/PDA integration is likely making it necessary to only carry one integrated device." This is reinforced by Dasgupta *et al.* (2009, p. 44) who highlighted "that the speed of change in technology meant that it might be possible in the future to use smart phone technology rather than PDAs".

In some of the studies, where the students purchased their own devices, it meant that although there would be a recommended device, it was found that students changed devices over the time of the study, whilst maintaining similar software (Hudson and Buell, 2011).

2.9 Infection control

PDAs and other mobile devices have been found, in a number of studies looking at healthcare settings, to be contaminated with normal skin micro-organisms and potentially pathogenic organisms (Hassoun *et al.*, 2004; Braddy and Blair, 2005; Singh *et al.*, 2010). Transfer of micro-organisms both to and from mobile devices has also been demonstrated (Jeske *et al.*, 2007; Morris *et al.*, 2012). Despite this, evidence of direct causation of disease from this type of contamination is lacking.

In a 2002 review, Neely and Sittig discussed the use of infection-control measures, such as covers (which prevent contamination and make disinfection easier), and normal procedures, such as hand-washing, cleaning and disinfecting. Braddy and Blair (2005) also recommended thorough hand-hygiene when using PDAs and other handheld devices. Cleaning with 70% alcohol wipes has been found to significantly reduce contamination (Hassoun *et al.*, 2004; Singh *et al.*, 2010). However, both Hassoun *et al.* (2004) and Singh *et al.* (2010) reported very low levels of mobile device cleaning and hand-washing before and after phone use.

3. Aims and Objectives

Due to practical considerations around the logistics of running the pilot across multiple professional groups and settings (higher education and clinical), and variance with the customisation of the Companion SD card, individual evaluations were conducted for each pilot. Data collection was carried out by a number of different researchers, across a number of institutions who customised the evaluations to reflect local practice. Consequently, data was not always directly comparable across the pilots. Regardless of where the data was collected and by whom, an analysis was conducted across the pilots by the authors. Despite this, all evaluations had some common goals:

- To pilot the use of the Companion Compendium with PDAs among pre-registration healthcare students (medical, nursing and pharmacy students, with the resource being customised for the latter groups).
- To investigate and compare reported use in academic and practice settings in order to gain an understanding of how and when the devices and resources were used to support learning and decision making.
- To gather staff and student perspectives on the usefulness of the PDA and resources, and ways in which the resources were used in other institutions.
- To assess the practicality and sustainability of using these resources.

4, Methods

A mixed methods approach to data collection was undertaken. Within each individual pilot the questionnaires were tailored to fit individual circumstances, all questionnaires had a qualitative component, which allowed the students to add free text responses to provide examples of how they had used the resources to support their learning.

4.1 Ethical Approval

Ethical approval for the various pilots was handled differently. For the Newcastle University medical student's pilot, the pilot had Board of Studies granted approval which allowed the students to have access to the PDAs and Companion compendium. For the pilots that were carried out at Durham University, full ethical approval from the University ethics committee was sought. On consultation with The University of Sunderland and Teesside University ethics departments, it was agreed that full ethical approval was not required, as the intervention was taking place in the practice setting and not the University setting.

4.2 Data Collection

The PDA and Companion compendium were piloted across multiple sites. For the CETL4HealthNE pilots all students were asked to complete an on-line questionnaire which used a mixture of techniques to collect data, including likert scales as well as free-text questions. Durham University completed their own evaluation which consisted of two questionnaires (one around halfway and the other at the end) and a blog per year group. For the first cohort of students, the second questionnaire was amended with additional questions in order to ascertain more about the use of both the PDA and Companion SD card. This amended questionnaire was completed by the second cohort of students on both occasions. All other students within the CETL4HealthNE pilots were asked to complete an on-line survey around the time they returned their devices and resources (please see Appendices A – F for further information regarding the questionnaires). All students were asked whether they were interested in being contacted for a brief follow-up on issues related to the pilot.

Where possible, PDAs and the Medhand software were issued to both to the lecturer and to supporting staff in the placement so that they understood what the resource was and could comment on what would be their perceived benefits to the student having access to this resource. Due to time constraints and issues of access, the only supervisors with whom interviews were conducted were the pharmacy lecturers. In addition, feedback was collected from Librarians' within the NHS about the resource and these have been incorporated into the findings.

As part of the evaluation, interviews were carried out with other HEIs who were using similar combinations of PDAs and software supplied by Medhand International. In some cases Medhand International had worked closely with institutions in order to customise either collections or how the Companion compendium software was updated etc. The institutions visited were Brighton and Sussex Medical Schools and Leeds University. Part of the evaluation was to try and identify a sustainable way of accessing the resources.

4.3 Data Analysis

Data was coded into emerging themes independently by the two authors in relation to the objectives of the study. The emerging themes were then compared and any repeating themes were provisionally accepted; themes which were individual to each project were debated between the researchers regarding validity and inclusion as findings.

During preliminary data analysis for the interim reporting stage, the evaluation team coded data into emergent themes; the key themes were usage and factors affecting use. This formed the basis of framework analysis (Ritchie and Spencer, 1994; George and Davidson, 2005; Srivastava and Thomson, 2009), which was utilised throughout data analysis, with the two authors coding data into subsets of the key themes. To ensure accuracy, each theme was broken down into several sub-themes. It was not feasible to include all data in the report, so those that were most representative of the themes have been included. Any disagreements were resolved via a discussion within the research team. Findings will be discussed as a reflection of the evaluation aims and analytical framework.

5. Findings

Within the data participants were assigned a code relating to their profession and institution. The following key displays how these are presented:

DUR Medical	Durham University 2nd Year Medical Student
NCL James Cook Medical	Newcastle University 5th Year Medical Student (James Cook)
NCL Medical	Newcastle University 5th Year Medical Student
Nursing	Teesside University 3rd Year Nursing Student
Pharmacy	University of Sunderland 3rd Year Pharmacy Student

5.1 Response Rates for the on-line questionnaire

Professional Grouping	Institution	Year of study	HEI/NHS	No of PDAs issued	No who Completed feedback	Overall Response Rate
Medicine	Durham University[3]	2nd	HEI	55	55 & 51	100% and 93%
Medicine	Durham University	2nd	HEI	47	27 & 26	57% and 55%
Medicine	Newcastle University	5th	NHS	45	8 (9*)	17.78% (20%)
Medicine	Newcastle University	5th	NHS	121	36 (38*)	30% (31%)
Nursing	Teesside University	3rd	NHS	42	22 (25*)	55% (60%)
Pharmacy	University of Sunderland	3rd	Placement	14	8 (9*)	50% (64%)

Table 3: Response rates for the on-line questionnaire for all pilots

*The figures in brackets are the total number of respondents, however, of those a number of respondents failed to complete all questions in the questionnaire and their responses have been omitted when calculating resource usage.

All students were asked as an additional question on the questionnaire, whether they were interested in being contacted for a brief follow-up on issues related to the pilot but this had a null response rate.

[3] As part of the evaluation at Durham University the students completed two questionnaires.

5.2 Prior Usage, platform usage and frequency of usage

All students were asked about whether or not they had used a PDA prior to the trial and whether they had used the resources with other computers.

5.2.1 Prior PDA experience among students

Between zero and seventeen per cent of students asked had used a PDA before the trial.

5.2.2 Platform usage

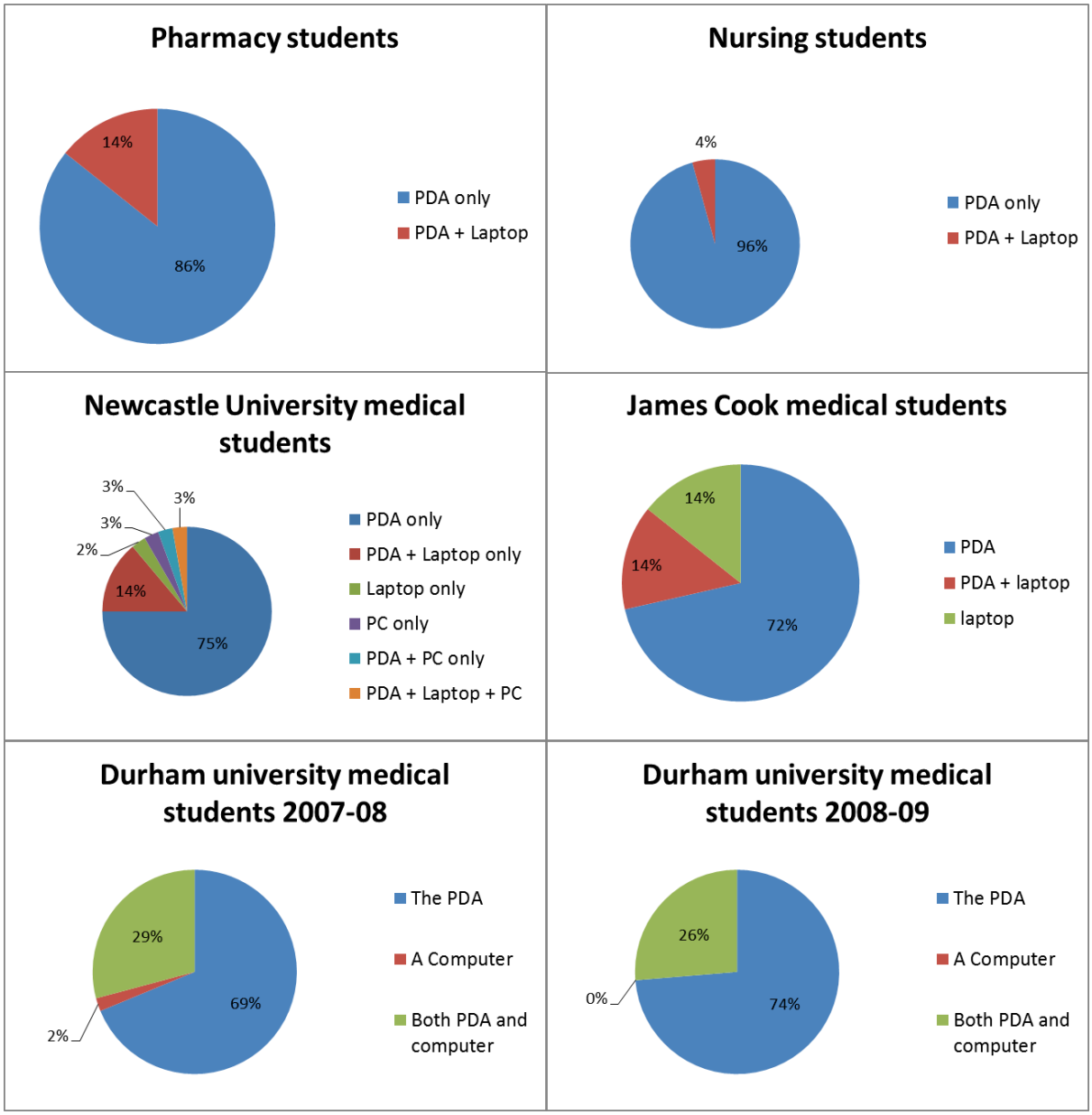


Figure 1: Use of the Companion software by platform (PDA, PC or laptop) across the pilots

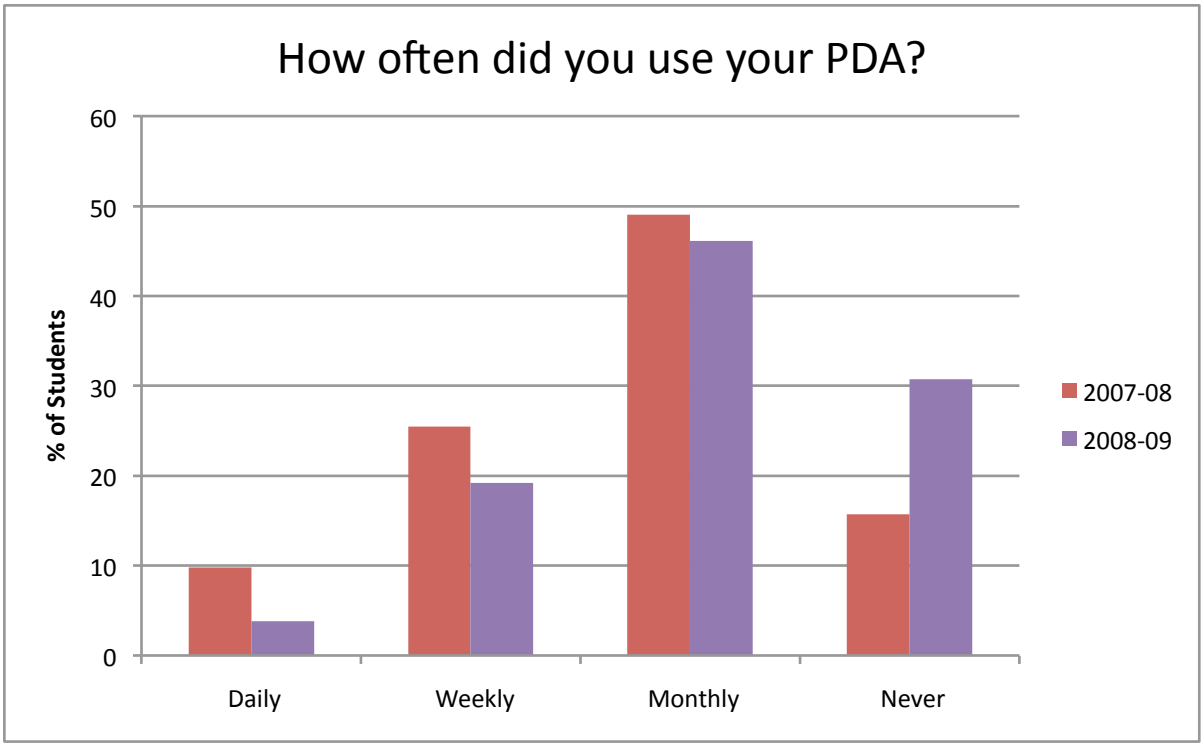
Across all projects, the Companion compendium was used by the majority of students in PDAs, however some students chose to use the resource additionally in either a laptop or desktop computer (see fig 1). In addition, a few students used the Companion compendium solely in their laptop or desktop pc. Interestingly, some students commented that they

would have liked to access the resources on a computer despite this option being available to them:

> *"I think it would be more useful to have this kind of programme on a home computer/workstation computer rather than on a PDA." (The University of Sunderland Pharmacy Student)*

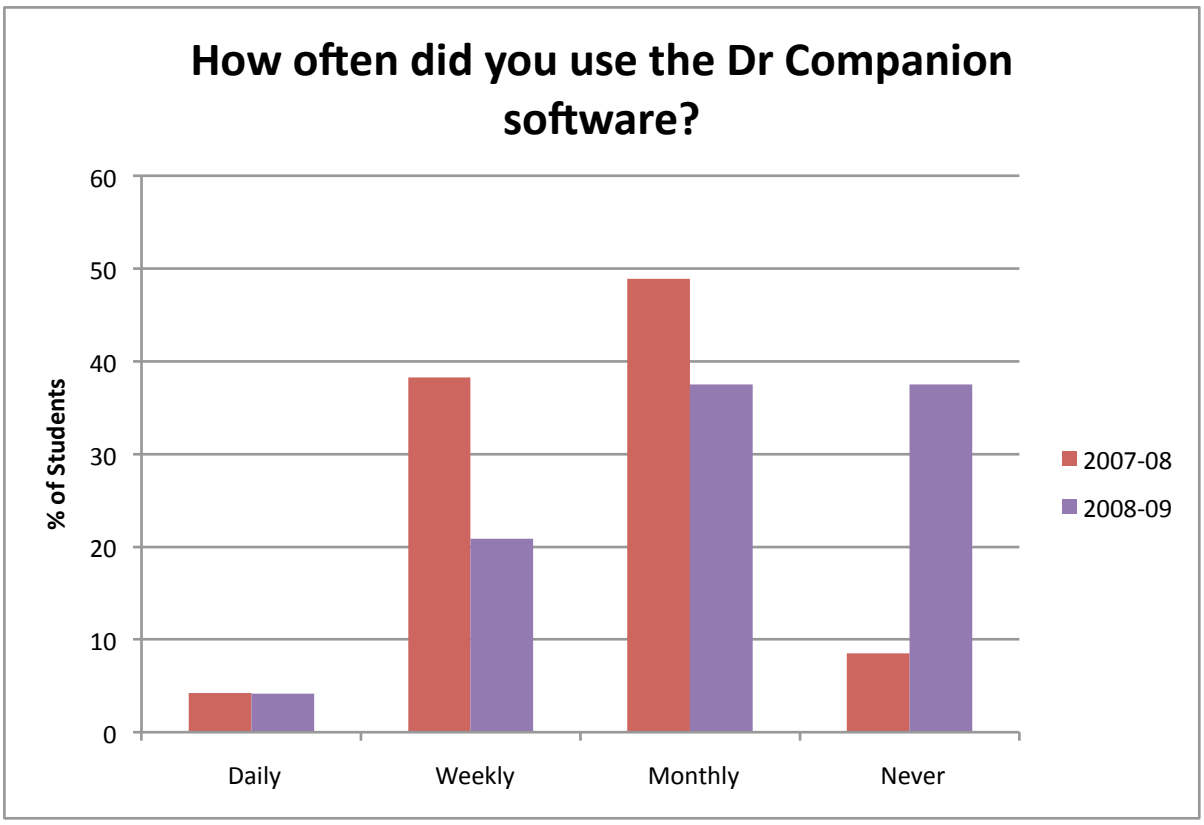
5.2.3 Frequency of overall use

Only Durham University medical students were asked to report their frequency of use of the PDA and Companion Compendium (see Graphs 1 and 2 below). There was a difference in use of both the PDA and Companion compendium between the two cohorts of students, with the 2007-08 cohort reporting more frequent use than the 2008-09 cohort.



Graph 1: Durham University Frequency of Usage of PDA

The majority of students used both the PDA and Companion compendium software monthly, however frequency of use was reportedly greater for the Companion compendium, than for PDAs.

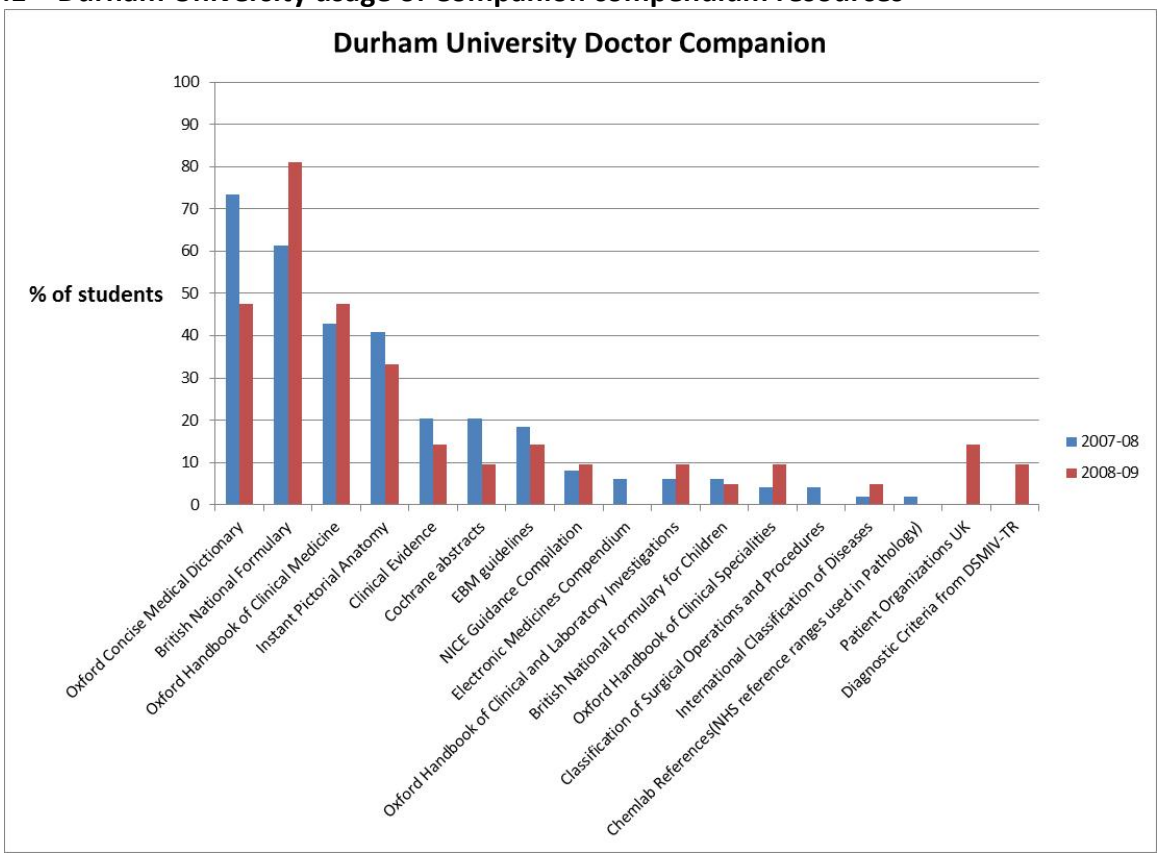


Graph 2: Durham University Frequency of Usage of Companion compendium

5.3 Resource usage

A number of students accessed Student Consult resources (electronic resources accompanying books published by Elsevier, http://www.studentconsult.com/), lecture notes and videos through the PDA. However, the main resources used were those in the Companion compendium.

5.3.1 Durham University usage of Companion compendium resources



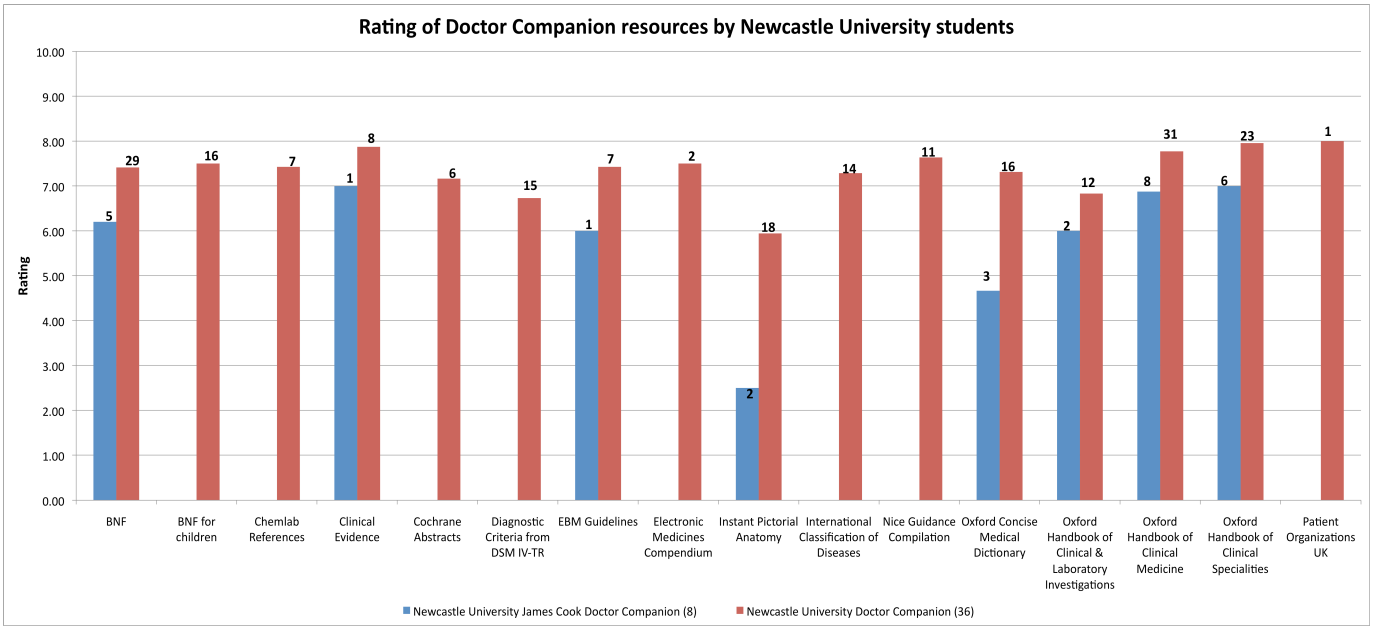
Graph 3: Resources used by Durham University medical students (self-reported)

Durham University students reported primarily using the Oxford Concise Medical Dictionary, British National Formulary (BNF), Oxford Handbook of Clinical Medicine and Instant Pictorial Anatomy. There was a small degree of variation in resource usage across the two cohorts. Durham medical students were not asked to rate the Companion compendium resources.

5.3.2 CETL4HealthNE pilots ratings for Companion Compendium resources

All students, apart from those in the Durham University pilot, were asked to rate the Companion compendium resources on a scale of 1 to 10 for those that they had used on more than one occasion: where 1 was of low quality/not useful at all to 10 which was very useful/indispensable. For each pilot, the average rating is shown for each of the Companion compendium resources. Numbers indicate the number of students who rated each resource.

5.3.2.1 Newcastle University Medical Students ratings of Dr Companion resources



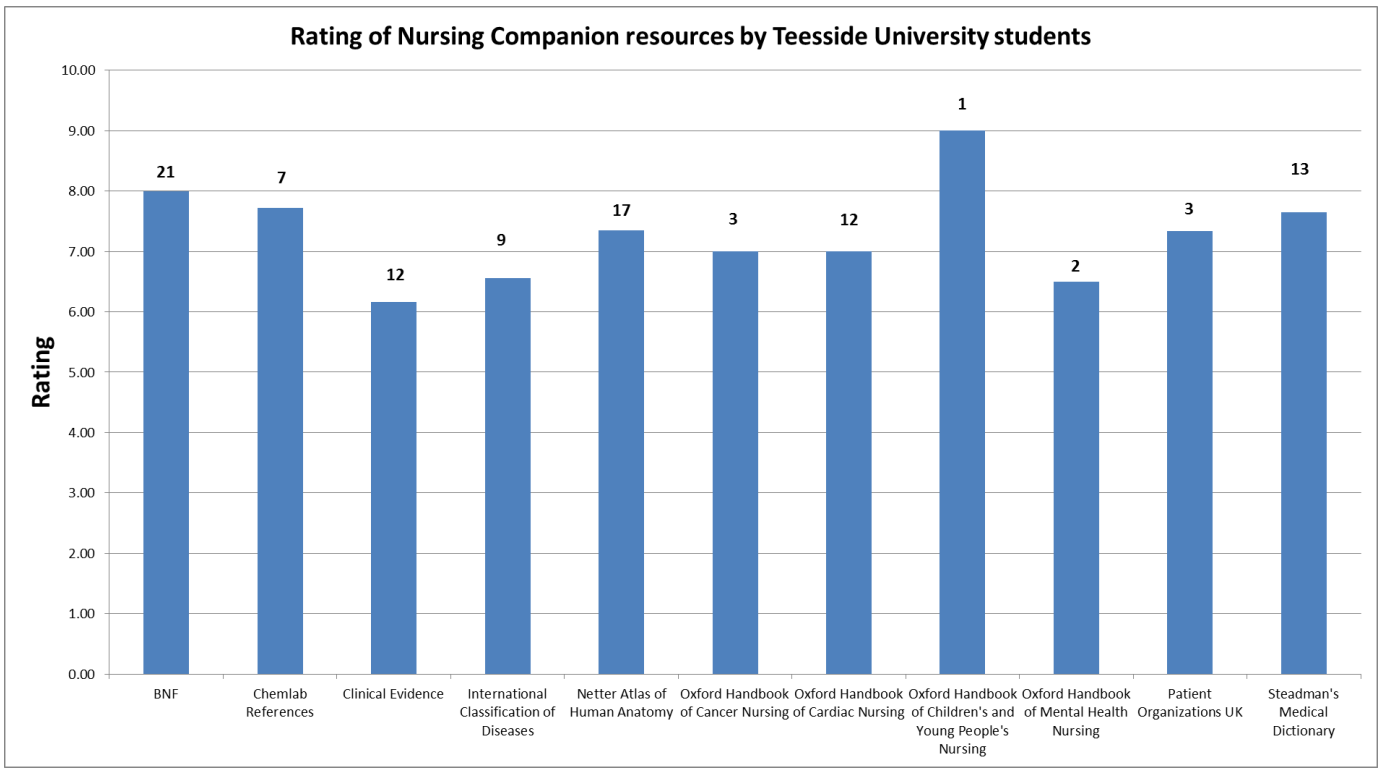
Graph 4: Rating of Doctor Companion resources by Newcastle University students

Graph 4 shows the average ratings of resources by Newcastle University medical students. Classification of Surgical Operations and Procedures was ommitted as it was not used by any students in these pilots.

Average ratings from James Cook University Hospital medical students (n=8) ranged from 2.50 for Instant Pictorial Anatomy to 7.00 for Clinical Evidence and the Oxford Handbook of Clinical Specialities, although Instant Pictorial Anatomy and Clinical Evidence were rated by a small number of students (2 and 1 respectively). The Oxford Handbook of Clinical Medicine was also rated highly (6.88) but was used by all students. None of these students reported using the BNF for children, Chemlab References, Cochrane Abstracts, Diagnostic Criteria from DSM IV-TR, Electronic Medicines Compendium, International Classification of Diseases, Nice Guidance Compilation or Patient Organizations UK.

Newcastle University medical students (n=36) rated resources from 5.94 for Instant Pictorial Anatomy to 8 for Patient Organizations UK; the latter was only rated by 1 student. The most used resources were the BNF (rated 7.41), the Oxford Handbook of Clinical Medicine (rated 7.77) and the Oxford Handbook of Clinical Specialities (rated 7.96). The Electronic Medicines Compendium, although rated 7.5, was only used by 2 students. Chemlab references (rated 7.43), Clinical Evidence (rated 7.88), Cochrane Abstracts (rated 7.17) and EBM Guidelines (rated 7.43) were all used by fewer than 25% of these students.

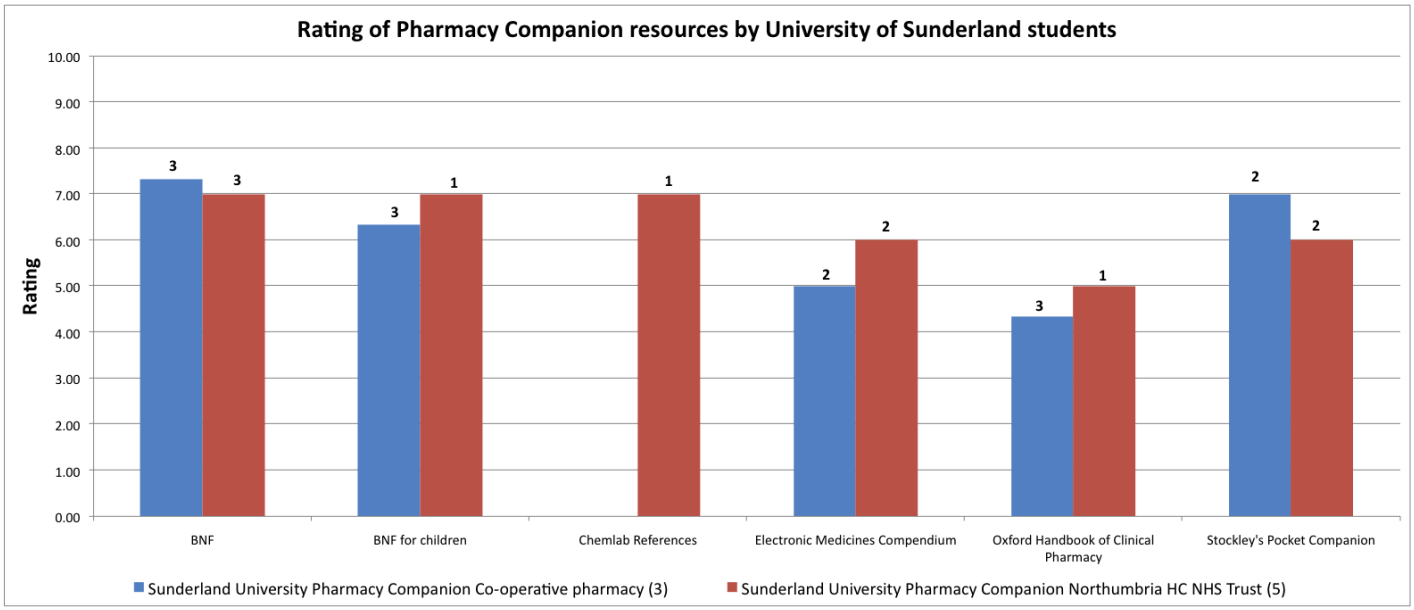
5.3.2.2 Teesside University Nursing Students ratings of Nursing Companion resources



Graph 5: Rating of Nursing Companion resources by Teesside University students

Graph 5 shows the average ratings of resources by Teesside University nursing students (n=22), which varied between 6.17 and 9.00, with the Oxford Handbook of Children's and Young Persons Nursing the highest rated resource, although this was only rated by 1 student. The BNF (8.00), Chemlab references (7.71) and Steadman's Medical Dictionary (7.64) were next most highly rated, and were rated by greater student numbers (21, 7 and 13 respectively). Clinical Evidence was rated lowest (6.17, 12 students).

5.3.2.3 The University of Sunderland Pharmacy Students ratings of Pharmacy Companion resources



Graph 6: Rating of Pharmacy Companion resources by The University of Sunderland students.

Student numbers in these groups were low, and the number reporting Companion compendium resource usage was very low (Co-operative pharmacy n=3, Northumbria HC NHS Trust n=5). Of the resources provided, the BNF was used most frequently by pharmacy students in both groups (all Co-operative pharmacy students, and 60% of Northumbria HC NHS Trust students). All students in the Co-operative pharmacy also used the BNF for Children and the Oxford Handbook of Clinical Pharmacy and two thirds used the Electronic Medicines Compendium and Stockley's Pocket Companion. This group did not report use of the Chemlab references. Reported usage by Northumbria HC NHS Trust students was quite different; only 40% reported using the Electronic Medicines Compendium and Stockley's Pocket Companion and 20% of these students used the BNF for Children, Chemlab references and the Oxford Handbook of Clinical Pharmacy.

Ratings ranged from 4.33 to 7.33 for the Co-operative pharmacy, and 5.00 to 7.00 for the Northumbria HC NHS Trust.

Co-operative pharmacy students rated the BNF most highly (7.33), followed by Stockley's Pocket Companion (7.00) and the BNF for Children (6.33). Ratings for the Electronic Medicines Compendium (5.00) and, in particular, the Oxford Handbook of Clinical Pharmacy (4.33) were low.

The average rating by Northumbria HC NHS Trust students was highest for the BNF, BNF for Children and Chemlab references (all rated 7.00). Ratings were lowest for the Electronic Medicines Compendium (6.00) and Oxford Handbook of Clinical Pharmacy (5.00).

5.4 Feedback on individual resources within the Companion Compendium

5.4.1 Anatomical resources

Each Companion compendium contained an anatomical resource; either Instant Pictorial Anatomy or Netter's Anatomy. These received mixed comments from students, with some finding them useful, especially for revising and in clinical settings.

> *"It helped me to revise basic anatomy without needing to search through a detailed anatomy text book." (NCL Medical)*

> *"Anatomy for understanding how a procedure would be carried out for an operation." (Nursing)*

> *"In an accident and emergency setting - looking up particular bones." (Nursing)*

> *"used the instant anatomy to look at the anatomy of the shoulder when observing a joint injection." (NCL Medical)*

> *"Very useful for quick revision during ward rounds for surgical cases on paediatrics rotation." (NCL Medical)*

> *"...when I was struggling with the different cranial nerves I used the pictorial anatomy to make things easier for myself to understand" (DUR Medical)*

Others found it others less useful, mainly due to viewing pictures on a small screen (see section 7.1.2.1.5), but also because the Instant Pictorial Anatomy was perceived to lack the required depth.

> *"The anatomy section sounded like a great plan, but is a nuisance to navigate and is no match for a big book with big pictures." (DUR Medical)*

5.4.2 Medical Dictionaries

Companion resources included a medical dictionary; either the Oxford Concise Medical Dictionary or Steadman's Medical Dictionary. They were very popular and mainly used for looking up definitions.

> *"I used [it] to discover identity of medical terminology in the theatre setting." (Nursing)*

> *"Steadman used in theatres to understand what operation was being performed." (Nursing)*

> *"When I didn't know how to spell a medical term or needed a definition." (Nursing)*

> *"When not understanding what a word in textbook meant. Checking the definition of various gynae surgery terms in the dictionary app…" (NCL Medical)*

5.4.3 British National Formulary – including BNF for Children

The British National Formulary (BNF) was frequently utilised by students in various scenarios. Reported uses included investigating unfamiliar drugs and checking dosages, side effects, contra-indications, treatment options and mechanisms of action.

> *"Learning my common used medications within my placement" (Nursing)*

> *"I used the BNF regularly in the pharmacy placement to look up drugs that I was not familiar with and to check doses that were being queried by the pharmacist I was working with." (Pharmacy)*

> *"To gain an insight into the various drugs used within the theatre environment." (Nursing)*

> *"The childrens BNF-e.g. used when trying to prescribe steroids for asthmatic child." (Pharmacy)*

> *"When writing up kardex it was easier to use this than the paper version." (NCL Medical)*

The availability of paper copies of the BNF influenced use:

> *"...others like the BNF are very important but so widely available, that it's easier just to look at the paper versions." (Pharmacy)*

> *"I used the BNF again at home where I did not have a recent copy of the book handy." (NCL Medical)*

> *"Children's BNF was useful when an adult only version was only available on the ward." (Pharmacy)*

5.4.4 Oxford Handbooks

A range of Oxford Handbooks were provided on the Companion chips, dependent on the cohort of students. They proved popular and were used frequently.

> *"I think all the oxford books in one is really helpful and it's easy to cross reference things and look for explanations that you may have missed in lectures!" (DUR Medical)*

> *"The oxford handbooks were used most - excellent to have this in a form that could be carried in my pocket." (NCL Medical)*

The Oxford handbooks were used in a number of different ways, including as a quick reference, for revision and self-directed learning, to clarify understanding and in the diagnosis and treatment of patients (see sections 5.5.1.3.2.and 5.5.1.3.2).

5.4.5 Stockley's Pocket Companion

Pharmacy students had access to Stockley's Pocket Companion as part of Pharmacy Companion:

> *"When checking a script with many drugs, if I had the time I would type the main ones into stockley's just to see if they reacted with anything else on the script and to see if it was a serious reaction." (Pharmacy)*

> *"Useful on a couple of occasions when reviewing patient medication charts to have access to Stockley's drug interactions on the ward rather than having to return to the dispensary to consult the hard copy held there." (Pharmacy)*

5.4.6 DocTool Search

The DocTool Search, although available from the start of the pilots, was modified by Medhand International part-way through the pilots. Initially this search tool only searched by individual resource, but later in the pilots it searched across all resources within the companion compendium. Students in the later pilots commented on the usefulness of the search tool in finding information:

> *"I used the doctool a lot if I ever had a query I would type it into doctool just to get a general over view about the drug." (Pharmacy)*

It was suggested that the DocTool could be improved by allowing the choice of which resources to search. A limitation to searching the resources was also identified by a number of students:

> *"When using the medical dictionary, if you struggle to spell a condition it simply didn't find it instead of offering alternative spellings." (Nursing)*

Whereas, with a book, students found browsing the index for words much simpler when unsure of spelling.

5.5 Themes

Two key themes emerged from the data, these were: usage – how the students used the PDA and companion resources and factors influencing the use of the PDA and companion resources.

5.5.1 Usage

Figure 2 is an attempt to capture the ways in which the PDA and Companion compendium supported learning across all of the pilots.

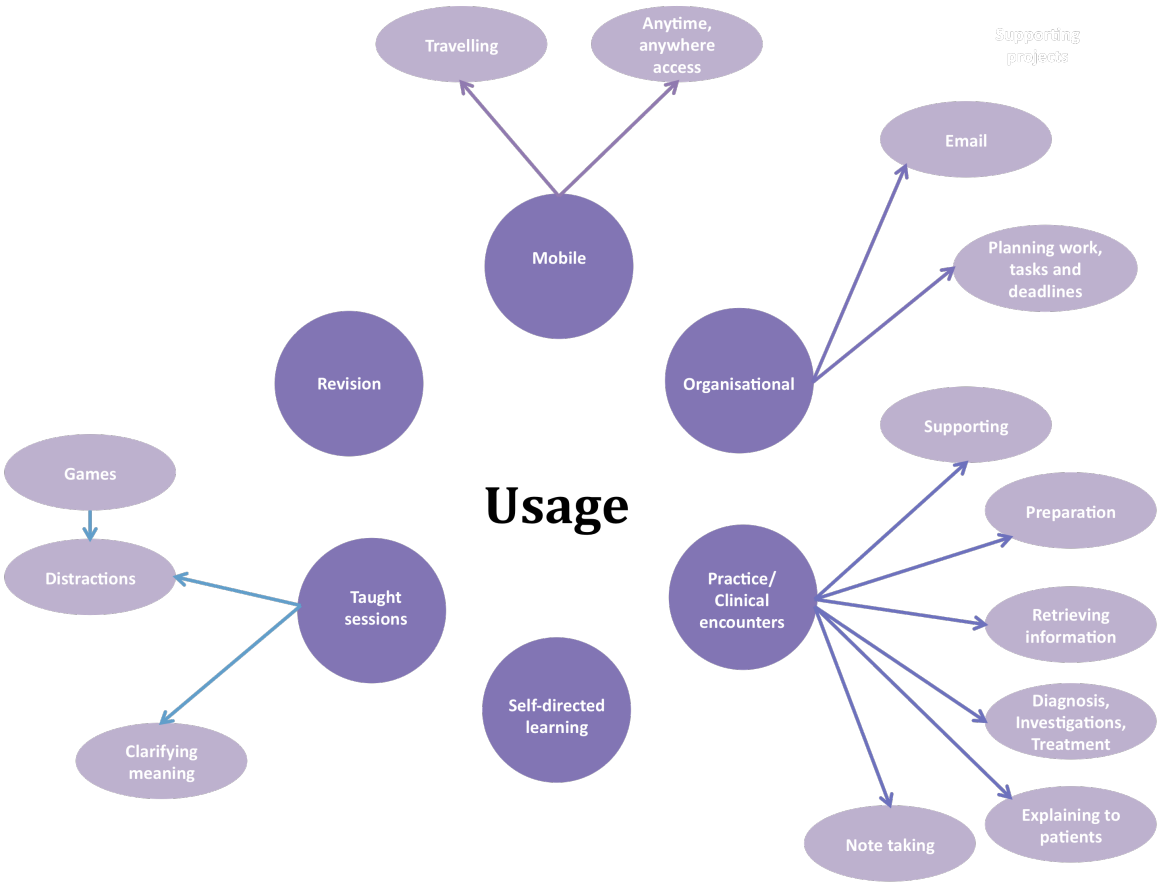


Figure 2: Usage of the resources to support learning

The only evaluation that directly asked the students if they felt that the Companion software had supported or improved learning were those of the pilots carried out at Durham University. Sixty three percent and fifty percent, in the 2007-08 and 2008-09 cohorts respectively, agreed that Companion compendium had "improved/supported their learning".

In the other pilots the students were asked to give examples of where and how they had used the reference materials to support learning/clinical decision making. From the qualitative data in all the pilots the main areas to emerge are discussed below:

5.5.1.1 Mobile Learning

One of the biggest themes to emerge was mobile learning, and the ability to access resources and learn wherever and whenever the students wanted. For example:

> *"The fact that so much information can fit into my pocket is very attractive, and my instant access is an empowering experience, knowing that I could at any point, almost anywhere access relevant medical information is reassuring." (DUR Medical)*
> *"Portable, easy to carry, instant access to vast array of information whilst in clinic/hospital etc so if unsure on something do not have to wait to go home or library. easy to access information. easy to use" (NCL Medical)*

> *"Allows quick access to less frequently used resources that are not available as hard copy on the wards. (eg medicines compendium and Chemlab)." (Pharmacy)*

"Quick, easy, at hand, a lot of information within it, videos/pictures of procedures for better visual understanding." (Nursing)

"Watching DR [dissection room] videos: while you eat, while you cook, while you wait, when you have 15 mins to spare, anywhere, anytime....the best thing ever." (DUR Medical)

The portability of the device also facilitated studying whilst travelling, e.g. daily commuting or longer journeys.

"An easy way to... read lecture notes, e.g. whilst on bus." (DUR Medical)

5.5.1.2 Facilitating organisation

The PDAs were used to support learning by allowing students to organise appointments and tasks, plan work, take notes, check emails and remember assignment deadlines. The majority of the feedback relating to this area is from Durham University students:

"its good for remembering… assignments hand-ins" (DUR medical)
"The calendar/organiser is very useful in planning work, deadlines etc" (DUR medical)

"I found the calendar function extremely helpful as I could carry my timetable around electronically also" (NCL Medical)

"Calendar, using it to keep a diary of dates and make notes and tasks. It helps with organisation." (DUR medical)

"*I also find the notes very helpful, particularly the recorder."* (DUR Medical)
"The tasks which I can refer to and delete as done, better then lots of bits of paper with lists on." (DUR Medical)

5.5.1.3 Practice/clinical encounters

Across all the pilots there is evidence that the students found the companion compendium useful whilst meeting patients for their projects or when on clinical placement. The majority of students reported that use was predominantly 'outside the patient encounter', followed by 'after patient contact'.

"I used them as I was caring for patients, if I did not understand or needed to know a specific detail I would look them up, particularly in those that gave me details of drugs or anatomy and physiology... different ones at different times." (Nursing)

"On wards when i wanted to look up a diagnosis or management plan I would use the oxford handbooks." (NCL James Cook Medical)

"... where I needed to access information quickly and briefly in between clinical settings such as in clinics when something I was unsure about came up. BNF also useful to use during ... clinical scenarios on wards etc. (NCL Medical)

"it was useful to be able to find out information quickly to a range of real life learning opportunities that i encountered whilst on the wards." (NCL James Cook Medical)
"Mainly used as a quick reference guide, e.g. dictionary/Oxford handbook on the ward/in clinics." (NCL Medical)

"*used oxford handbook and dictionary on paediatric rotation to remind myself of topics previously covered which i encountered throughout the rotation but could not remember."* (NCL Medical)

"the ICD-10 was used most during the mental health rotation. It was invaluable and helped me to learn the criteria for certain conditions." (NCL Medical)

"To consolidate learning after ward round." (NCL Medical)

A small proportion of students self-reported using the resource before an encounter:

"... understanding how a procedure would be carried out for an operation." (Nursing)
" BNF to find the side effects of anaesthetic drugs while on placement in theatres." (Nursing)

"*Steadman used in theatres to understand what operation was being performed."* (Nursing)

Only a minority of students reported using the resources during a patient encounter (see 7.5.1.3.4 Explaining to Patients). Although, there was evidence that they had been used whilst taking patient histories:

"I used the electronic medicines compendium when taking patient histories in order to confirm the active ingredients in over the counter medicines." (Pharmacy)

"When taking a history from a patient on the ward I used the Dr Companion to look up their medication in the BNF. This was convenient and saved me the time of locating a book. It also enabled me to stay with the patient and continue to interact with them so they were aware that I was focusing my attention on their problems." (NCL Medical)

5.5.1.3.1 Preparation

Companion resources were used in preparation for meeting patients and dealing with clinical cases:

"...is great to have background info up when speaking to patients (patient study) about their condition as a reminder of what they might mention and any clinical signs." (DUR Medical)

"I read some of the oxford handbooks while researching my community placement and found the parts on ethics and dying really helpful (as my placement was in a hospice)" (DUR Medical)

"I used the handbook for cardiac nursing quite often as I was placed on coronary care unit it was helpful to get an understanding of some of the diseases of the heart. I also found the handbook useful on procedures that were used within coronary care." (Nursing)

"The section in the Oxford Handbook of Clinical Specialities was useful during this rotation [Women's Health] as certain principles were new and it was good to be able to have a learning aid at hand for quick access to information." (NCL Medical)

5.5.1.3.2 Retrieving Information

Information from the Companion resources was useful in a range of clinical circumstances, including clarifying knowledge:

"During community placement when people would use medical terms and assume I knew what they were talking about because I was a medical student the PDA enabled me to look the terms up" (DUR Medical)

"I used them as I was caring for patients, if I did not understand or needed to know a specific detail I would look them up, particularly in those that gave me details of drugs or anatomy and physiology..." (Nursing)

"To get a more detailed look/explanation of procedures if the staff at hand were too busy and/or did not know themselves." (Nursing)

"After any emergency procedure I could use the companion suite to get a better understanding of the event." (Nursing)

5.5.1.3.3 Diagnosis, investigations and treatment

During clinical placements, students frequently used Companion resources to help with diagnosis, investigations and treatment:

"I used the Oxford Handbook of clinical specialities to look up the differential diagnosis of leg pain in a child." (Nursing)

"used the handbook of clinical and lab investigations to justify investigations to perform, and their significance" (NCL James Cook Medical)

"Used clinical evidence to help with management plans." (Nursing)

"NICE guidelines helped in formulating management plan for lady with heart failure." (NCL Medical)

"on wards when I wanted to look up a diagnosis or management plan I would use the oxford handbooks" (NCL James Cook Medical)

"Oxford Handbook of Clinical Specialities, whilst on the wards and clinics was looking up for different diseases, symptoms, management issues, and treatment approaches." (Nursing)

"Useful for looking up conditions and their management quickly in surgery. Chemlab References aided my evaluation of results. Looking at evidence base." (NCL Medical)

5.5.1.3.4 Explaining to Patients

A number of students commented on their use of the resources to explain a medical procedure to a patient:

"Having an understanding of A&P [anatomy and physiology] at hand while on placement was reassuring for me to get a quick guide If needed to understand the heart and the chambers within it and to help patients understand and pictures for them to see" (Nursing)

"I used it to gather evidence of procedures and how I would be able to explain to a patient what would be involved and how the procedure would be carried out." (Nursing)

5.5.1.3.5 Note taking

Subsequent to patient contact, students recorded notes on the PDAs:

"Storing immediate experiences following clinical encounters as a learning portfolio tool. It was more efficient than making notes and then having to type them up later." (DUR Medical)

"The hand scribed word documents facility was amazing. I used this a lot to write brief notes after patient encounters which could then be transferred to larger documents for patient study documents etc." (DUR Medical)

5.5.1.4 Self-directed learning

Some students used the Companion resources for self-directed study:

"I used the BNF, the Oxford Handbook of Clinical Medicine, and the Oxford Handbook of Clinical Specialities for self directed study, for example, completing the study packs during spare time on the primary care rotation." (NCL Medical)

"During the Essential Senior Rotations we have a certain amount of scheduled white time or self directed study time. The Dr Companion allowed me to be able to study wherever I was efficiently. I didnt have to carry around large amounts of heavy books as it had all I needed on it. Even for psychiatry it had the ICD-10 and DCM-IV. Even if it wasnt scheduled white time if I had half an hour to wait, for example in a clinic for the next patient or waiting for a doctor to come to a ward round, it meant that I could use the time effectively to direct my learning and further my knowledge. Again the Dr Companion allowed me to have all the books I needed in a handheld form and it was very easy to use." (NCL Medical)

5.5.1.5 Taught Sessions

Students reported using PDAs/Companion compendium in taught sessions in a variety of ways:

5.5.1.5.1 Clarifying Meaning

Students used the PDA and companion compendium to clarify meanings when the instructor assumed prior knowledge of relevant, in particular clinical, terminology or when understanding varied between students.

> *"I wasn't sure what the lecturer was talking about in one lecture as I had forgotten the meaning of a word so was able to look it up quickly on the PDA and keep on track with the lecture" (DUR Medical)*

> *"The Dr companion software provided very concise information which is exactly what you want when you need information fast. For example, a lecture would give a lot of information on a particular disease - possible mechanisms, lots of drugs, and it would often blur the subject. Dr companion got straight to the point - this is what we know about it (in a few sentences), these are the drugs to treat it, when to treat it, and how to diagnose it. Perfect." (DUR Medical)*

5.5.1.5.2 Distractions

Devices also proved distracting, whether interrupting concentration on the session when searching for relevant information, or providing alternative occupation (reading material on another topic or playing games) during 'boring' sessions. Distraction was also mentioned during learning outside taught sessions:

> *"When I try to use such things as the dictionary or Dr. Companion chip in lectures I find it a distraction as by the time I have retrieved and read the necessary section the lecture has moved on considerably and I have missed other things." (DUR Medical)*

> *"Could be a definite distraction. Akin to 'Wikipedia surfing', whereby in innocently looking up one thing, you follow links to other things and end up spending hours on it when all you wanted to do was look up a drug name quickly. For this reason, I retreated to the print version of the BNF so that I could actually finish my Patient Study." (DUR Medical)*

5.5.1.6 Revision

Companion compendium proved useful for revision and consolidation for many students, with the ability to access a large number of resources in a small device being a particular benefit.

> *"I particularly found this useful during revision for the Jan exams as it was easy to use without having another book on the table." (DUR Medical)*

> *"…having everything you need in one place really makes learning more easy and …generates [a] conducive environment to study." (DUR Medical)*

"Revising/reading up on subject at home or in garden (antibiotics)." (NCL Medical)

"To consolidate learning after ward rounds." (NCL Medical)

"For pre-assessment revision." (NCL Medical)

"To find out staging of gynae cancers whilst in theatre and consolidate learning there and then." (NCL Medical)

5.5.2 Factors influencing use

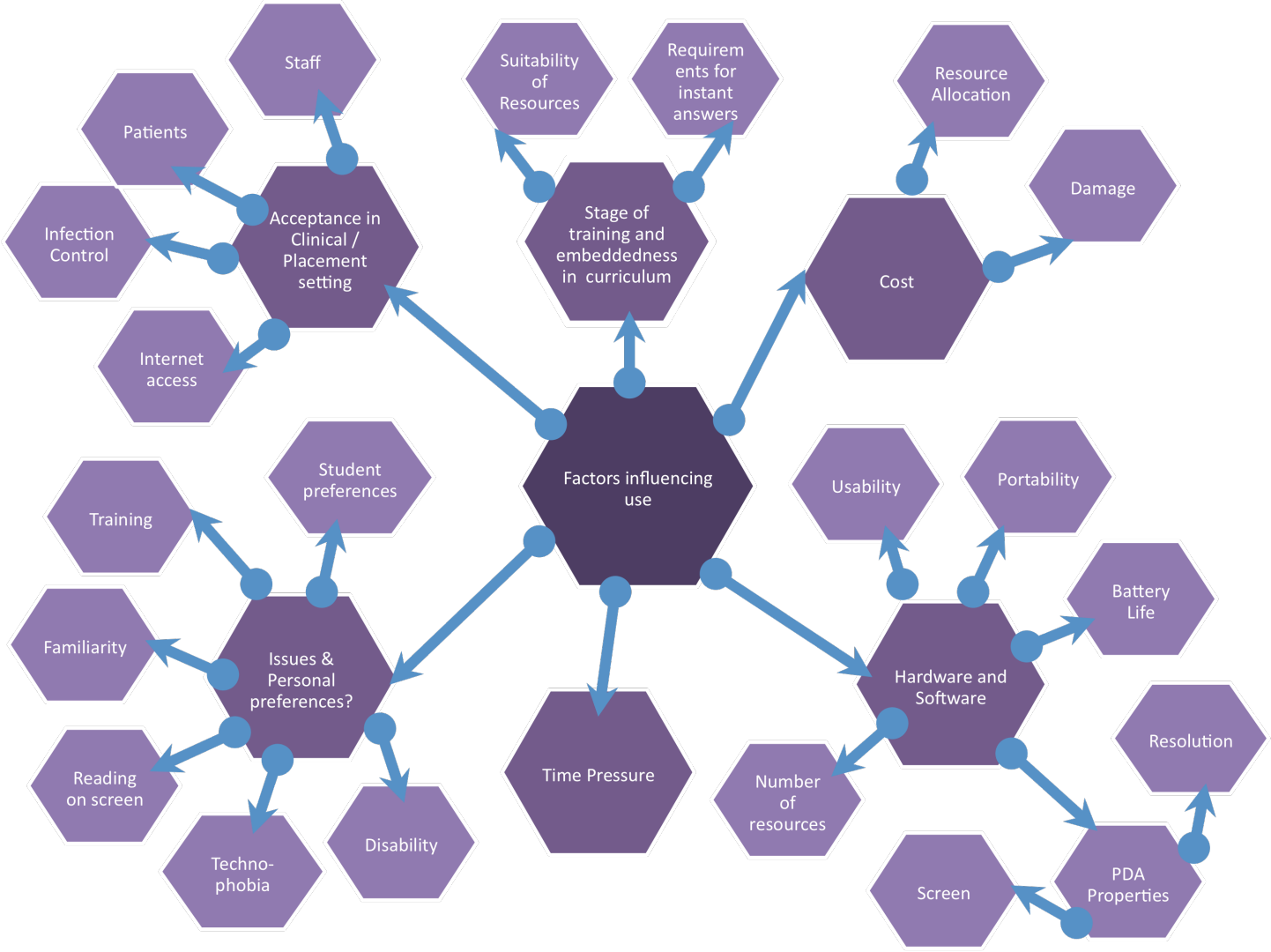


Figure 3: Subthemes related to factors influencing the use of PDAs and Companion compendium

The second major qualitative theme included the positive and negative factors which influenced students' use of the devices and resources and is depicted in Figure 3.

5.5.2.1 Hardware and Software

A variety of subthemes emerged illustrating the perceived pros and cons of using electronic versus paper resources, such as books. In addition, subthemes arose around the advantages and disadvantages of computers and laptops versus PDAs.

5.5.2.1.1 Usability

Comments relating to usability fell into two main categories, the perceived ease, or difficulty, of use.

5.5.2.1.1.1 Ease of use

Some students found using the PDA easier and more efficient than the equivalent books:

> *"it is easy to use and designed perfectly for people like me who have not used this system before." (Nursing)*

> *"...it's so portable and easy to use, compared to having to trawl through the same text books" (DUR Medical)*

> *"It's much easier to use than searching through a pocket sized oxford handbook of medicine." (DUR Medical)*

> *"If the pharmacist asked me to look something up I was able to find it more efficiently when using the PDA." (Pharmacy)*

> *"Faster to find drugs than in paper BNF." (NCL Medical)*

> *"I used Dr Companion for the BNF and Oxford Handbook of Clinical Specialities during self directed study, as it was faster than looking through the relevant paper books." (NCL Medical)*

In addition, the instant switch on ability of the PDA was found to be useful:

> *"The PDA also turned on instantly, unlike the pc which takes ages to boot up and do things" (DUR Medical)*

Many students commented on the usefulness of quick access to reference material, particularly in clinical encounters:

> *"on a cardiac critical placement this resource was vital for me to have a quick reference guide of anything that has or would happen within my placement." (Nursing)*

"Oxford clinical handbook/specialities used in situations where I needed to access information quickly and briefly in between clinical settings such as in clinics when something I was unsure about came up." (NCL Medical)

5.5.2.1.1.2 Difficult to use

In contrast, a proportion of students found the PDA difficult to use or more time-consuming than equivalent resources in books or online. Additionally, some perceived the software itself as slow.

"slower than a book to access information. Eg: where hard copies of a book like the BNF are widely available on wards." (Pharmacy)

"often took longer to find the information needed. much quicker by internet." (Nursing)

"used during my general practice placement for ideally quick reference. In fact it was slow and frustrating and I subsequently stopped carrying it." (NCL Medical)

Control of the PDA was via a stylus and a small number of students commented on this, suggesting that finger control may be an improvement. Other difficulties were also experienced:

"Tapping with a stick, slow at typing words out, screen `frozen` sometimes which was frustrating." (Nursing)

5.5.2.1.1.3 Navigation was perceived by a few as poor and this reduced device usage:

"I used it for looking up certain disease; however I did not use it as much as I found it difficult to navigate." (Nursing)

"The system is not well organised, it is difficult to navigate and I rarely found it useful." (NCL Medical)

"If it is a very long page it is difficult and time-consuming to scroll to where you need to be." (NCL Medical)

"Oxford handbooks were very bizarre and unintuitive to navigate, the book format doesn`t lend itself well to digitalisation as you really need to be able to see a 2 page spread. BNF, again can`t really fit enough on the pda screen at once, so much slower to read through and can't jump sections as easily as in physical copy." (NCL Medical)

"Sometimes I did not completely understand the layout, for example the bnf I did not completely understand how to expand and find all the info on a certain drug, although it was good for the basics." (Nursing)

5.5.2.1.2 Portability

The PDAs were seen as valuable as they allowed students to study anywhere they had time to spare.

"I think the ability to have work with you at all times is very valuable." (DUR Medical)

"I can use it almost anywhere for revision or work" (DUR Medical)

"Information available in the palm of your hand." (Nursing)

"Having all my lectures to hand anywhere anytime" (DUR Medical)

The portability allowed use in clinical settings:

"It was useful to be able to find out information quickly to a range of real life learning opportunities that I encountered whilst on the wards." (Pharmacy)

"Portable, easy to carry, instant access to vast array of information whilst in clinic/hospital etc so if unsure on something do not have to wait to go home or library." (NCL Medical)

This instant access provided comfort to some students:

"Having the medical dictionary in my bag all the time. It offered a great sense of security, knowing that should I get a few moments free I could dig into it and answer questions from the day. It was like having a library in your pocket. Principally it made you feel time efficient as you could use it anywhere, always something to crib up on if you had time to kill." (DUR Medical)

"Portable, quick reference guide, handy and provides reassurance that always information available in your pocket." (NCL University Medical Student)

5.5.2.1.3 Battery life

The Acer PDAs were reported to have rather poor battery life, which had a major impact on their usefulness for those experiencing this issue; however few of the students reported this as an issue.

"The battery life was very poor and often when the PDA would have proved useful it was out of power." (DUR Medical)

"Main problem was the PDA itself had a short battery life so I gave up using it after 2 weeks." (*NCL University Medical Student*)

"Battery discharged very fast so if it hadn`t been charged the night before then could generally only get about 30 seconds worth of use before the unit switched itself off." (*NCL University Medical Student*)

5.5.2.1.4 PDA screen size and resolution

Numerous students commented negatively on both the size and the resolution of the screen, chiefly in relation to viewing the anatomical resource, but also when reading:

> *"…if I'm honest, it's through my laptop and not on the PDA because the screen is too small to see the pictures well and when you make the picture larger it just annoys me that it won't fit on the screen…" (DUR Medical)*

> *"I like to see text and images all at the same time on a scale my eyeballs can resolve without a microscope. The screen on the PDA is too small to make it a practical alternative to a textbook for me." (DUR Medical)*

> *"Writing was often very small or maladapted for the size of the screen." (NCL Medical)*

One student summarised the dilemma of using such a device:

> *"The small screen, ...makes it difficult to read from the device, making books and laptops more of attractive option, but a screen any bigger would defeat the objective of its compactibility." (DUR Medical)*

5.5.2.1.5 Number of resources

One of the main advantages of the PDA and Companion compendium chip was seen as the vast quantity of information available to the students:

> *"It is handy having all of those books on a small device for quick reference – it is obviously not feasible to carry around text books all day." (DUR Medical)*

> *"It was useful to have a variety of books all available within one device." (DUR Medical)*

5.5.2.2 Time

A common theme across projects was that time pressure prevented use of the devices either completely, or during clinical settings.

> *"Frankly if I had time to open a text book I was pleased, to be messing about in a tiny screen trying to figure out what a book could offer me...there just wasn't the time." (DUR Medical)*

> *"Not a lot of time in practice to use the PDA so only used it outside of placement, or after finishing the shift." (Nursing)*

> *"Too busy in the pharmacy environment to use it." (Pharmacy)*

5.5.2.3 Issues and Personal Preferences

A number of student-related factors were identified which impacted upon usage.

5.5.2.3.1 Disability

A small number of students commented on the lack of support for those with disabilities:

> *"I used the PDA from time to time however it was not a vital part of my learning. This may be because of my preference for having information in a paper form this may be due to my poor eye sight. I find books easier to take in information." (DUR Medical)*

> *"How about adapting it in some sort of way to accommodate people with dyslexia." (Nursing)*

5.5.2.3.2 Technophobia

A proportion of students perceived their own level of technological ability as poor and this discouraged them from using the technology.

> *"Not being good at technology, I presumed it would be too difficult for me to use, and did not try hard enough to get to grips with it." (DUR Medical)*

> *"A ludite like myself would like a brief hard copy of the books back pages and table of contents so you can be more certain of finding the resources required. I am not techy and spending ages scrolling about really does not do it for me. Give me a leaflet to flick through and I'd then go in looking for it. The probing around in the dark made the whole thing quite inaccessible for me." (DUR Medical)*

5.5.2.3.3 Reading on-screen

In addition to the earlier comments about screen size, some students expressed a simple preference to read from books instead of on-screen:

> *"I did not use my doctor companion kit as I prefer to read from textbooks." (NCL Medical)*

Another respondent found the device was not ideal for extensive reading:

> *"Not suitable for reading large amounts of texts for a prolonged period of time - difficult to fit much information on one page." (NCL Medical)*

5.5.2.3.4 Familiarity

Familiarity was seen as a requirement and its absence drove students to use traditional resources.

> *"Had difficulty at first accessing some of the programs and getting around the PDA device itself." (NCL Medical)*

> *"I think it would be quicker to find information rather than looking online/in books once I became familiar with it." (NCL Medical)*

> *"I think the main problem I had with it was a lack of familiarity so my immediate reaction was to look information up in books." (NCL Medical)*

"It is difficult to find the information needed, whether with more experience using the PDA this would improve, I find it easier and quicker to locate information from textbook." (Pharmacy)

One additional aspect of familiarity was remembering to use the facility:

"Not taking the PDA with me." (NCL Medical)

"Difficult to get used to using it, i.e. making it a habit." (NCL Medical)

"kept forgetting to use it" (DUR Medical)

5.5.2.3.5 Training

Students underwent a basic training session on receipt of the equipment, and further drop-in sessions and support were offered, with negligible take-up. Despite this, requests were made for more training, specifically in the use of the PDAs and Companion compendium to support student learning.

One individual suggested a hands-on session to improve familiarity:

"Perhaps a tutorial when it is given out so students feel confident using it and therefore find it easier to get into the habit of using it." (NCL Medical)

5.5.2.3.6 Student preferences

Students expressed their preference for using books to retrieve information as it allowed them to find related information more easily than on the PDA:

"I've used the dictionary a little, but find I get better answers to my questions from a paper dictionary because I can scan the page for related words more easily and so build up a fuller picture of whatever it is I want to know." (DUR Medical)

"I feel at our level some of the books are more useful in paper form. For example the BNF I find it much easier to access information through the book as it will also give explanations whereas it is more difficult to retrieve this info form the PDA" (DUR Medical)

"Oxford handbooks were very bizarre and unintuitive to navigate, the book format doesn`t lend itself well to digitalisation as you really need to be able to see a 2 page spread. BNF, again can`t really fit enough on the pda screen at once, so much slower to read through and can`t jump sections as easily as in physical copy." (NCL Medical)

5.5.2.4 Acceptance in Clinical/Placement Setting

5.5.2.4.1 Staff Perceptions

Medical, nursing and pharmacy students identified issues relating to staff perceptions of the use of the PDAs as non-academic and unprofessional:

"…I need permission from ward manager before use… was rude to sit their going through the pda as it looks very similar to a phone, I did not want my mentors to think I wasn't interested into my placement, therefore I read books that were available from the ward than the pda." (Nursing)

"Staff at some placements were not happy about the use of them as they looked like mobile phones, even after reassuring them that they were for academic use and were actually hand held computers." (Nursing)

"the only negative is that if you are using it in front of a consultant, it looks like you are using a mobile phone rather than a palm top computer and they might think you are not concentrating" (NCL Medical)

"people mistook the PDF for a phone on the wards leading to problems" (Pharmacy)

One student suggested a potential solution:

"Have notices sent out to the placement areas to support our claims that we are only using them for academic benefits and not just messing around." (Nursing)

5.5.2.4.2 Patients

"Sometimes seemed inappropriate to use it in front of patients." (Nursing)

5.5.2.4.3 Infection control

Although only a small number of comments mentioned the risk of transferring infections via the PDA, this is an important concern.

"...did you read the study on the Dr's Pen? Things we use at the bedside and take away with us are a nightmare for infection control. You can bin a biro, or have one for every bed, but how do you sanitise a PDA if your patient has expressed something nasty on it?" (DUR Medical)

Fortunately, one student found that the device was *"easily disinfected" (Nursing).*

5.5.2.4.4 Internet access – NHS Firewalls

The PDAs were enabled for wireless internet; however they were incompatible with the wireless internet provision at Durham University. Despite this, students did use the wireless internet to access email and resources. Some students also expressed a wish to access wireless internet in the NHS:

"to allow connection to hospital wifi" (Nursing)

"Access to internet with available wireless connection" (NCL Medical)

"*it would be useful to enhance the internet access so that e-journals etc could be viewed*" (Nursing)

In order to gain permission for these devices to be used by students whilst on clinical placements the wireless functionality had to be disabled as it was impossible to get permission for them to connect whilst in the clinical setting.

5.5.2.5 Stage of training and embededness in the curriculum

There were numerous comments related to the appropriateness of the resources to the stage of training and the extent to which resources were embedded in the respective curricula. In particular, Durham University students commented. They were in the second year of their medical degree, which is largely non-clinical, with limited patient contact, except during two in-course projects (the Patient Study and the Community Placement). When asked if they thought the PDA and Companion compendium would be useful in the first two years of their degree, 42.9 – 66.7% of students responded positively. However, when asked about potential usefulness in future years of their degree, a greater proportion, 83.3 – 91.7% of students, responded positively.

The responses can be grouped into sub-themes relating to: the requirement for instant access to resources (related to the ability to access alternative resources) and the appropriateness of resources available on the Companion compendium chip.

5.5.2.5.1 Appropriateness of resources

The selection of available resources on the Companion compendium chip was called into question, particularly by Durham University students as they perceived them as inappropriate for their level of education; commenting that they were not the resources on their reading list, weren't aligned with their learning and that they were unsure what some of the resources would be useful for.

> *"There were a lot of books I had not been exposed to via the reading list etc. and did not spend time on as I was too busy trying to master those on the reading list." (DUR Medical)*

> *"I feel I would benefit from more science based books on the PDA at this moment in time, rather than the wide range of Clinical books on it." (DUR Medical)*

> *"Although a variety of books were available I did not use most of them as I did not know why I would, therefore I feel that perhaps the choice of books was not entirely appropriate to medical students at this stage in our studies." (DUR Medical)*

> *"Although I have to admit that I'm not sure what all the books are even for... I'm sure time will tell!!" (DUR Medical)*

There were a significant number of requests for specific books or resources, such as Kumar and Clark's Clinical Medicine, Macleod's Clinical Examination, Gray's Anatomy, Netter's Anatomy and Berne and Levvy's Principles of Physiology (Durham University medical students) and by clinically-based students for specific rotations:

"The lack of information about surgical procedures... I was based in a surgical area so the pda was not really much use to me... it was far faster and easier to just use the pc's and text books available on the ward." (Nursing)

A minority of students also felt that there was no requirement to use resources other than those provided in class and via the virtual learning environment (VLE):

"I apologise that I did not use the PDA fully. I had fully intended to, but realised that the information from DUO [Durham University's VLE] and class materials were quite sufficient. Looking up and familiarising oneself with the PDA was time consuming in itself." (DUR Medical)

Students also requested guidance on using the resources and integration into their learning:

"Make them more part of our self directed learning tasks so we had time to go in and find out what it could do for us." (DUR Medical)

'If we were shown what the text books could do for us...as they mainly were not ones on reading lists....we could have used them more." (DUR Medical)

5.5.2.5.2 Requirements for Instant answers

A number of Durham University students reported that they did not currently require instant access to material:

"As a 2nd year medical student it's very rare I need to check something immediately..." (DUR Medical)

'I feel that during phase 1 [the first two years], students have time to look things up on a computer and do not really need instant access to information" (DUR Medical)

However some appreciated the instant access:

"Quick access to questions you might not go and seek the answers to afterwards" (DUR Medical)

Many anticipated that rapid access to material would prove more beneficial in clinical settings when access to books might not be available or practicable:

"I can see this PDA being extremely useful in a hospital setting for when you need to know something quickly, but I feel that it is almost pointless to have at this stage." (DUR Medical)

"I can see it being more helpful in a hospital context where carrying a load of reference books around is not practical and sources of information such as text books are less readily available" (DUR Medical)

"I wouldn't say anything on it was not useful. I just think the Dr Companion programme would provide more benefit to us in Stage 3 when we are in hospitals and don't have time to find a textbook." (DUR Medical)

Students on clinical placements confirmed this perception:

"Handy to have something to look at if I could not reach the library/computer or books and was interested in further looking at something I had just encountered or did not fully understand in practice." (Nursing)

"I have repeatedly used Dr Companion, during all rotations, to look up drugs I was unfamiliar with and to check doses etc. It is handy to have in your pocket as BNFs are often not around in clinical areas when you want them and they are often out of date" (NCL Medical)

The software certainly helped me, since I was able to come to a decision as to the priority of the order of my differential diagnoses..... On reflection, I can see how the use of PDAs in the clinical setting can bring about improvements in patient care, making the process of clinical decision making quicker, and I encourage their use on the wards and in general practices." (NCL Medical)

5.5.2.6 Cost

Concerns were expressed about the cost of the equipment and University allocation of resources from fee income.

"I think it could be more useful in the clinical years, but I'm not sure we can excuse spending such a large amount on them at this stage. I realise that funding for different things comes from different pots and sources, but when some students are struggling to pay their tuition fees, one has to wonder if we oughtn't change our system." (DUR Medical)

"Although useful as a trial, the annual cost of the resources seems prohibitive and would represent poor value for the amount of use it would receive." (Pharmacy)

"the money that this would entail could be either better spent on us (NetAnatomy.com subscription), on staff (more contact time) or on the NHS (money being a huge part of its short-fallings)" (DUR Medical)

Additionally, students were concerned about damaging or losing the equipment, which, on occasion, resulted in a small number wishing to return the devices.

"The main barrier was that I was scared to lose it!" (NCL Medical)

"…was worried I would lose it in the theatres or someone would steal it." (Nursing)

"I also felt that I did not want to take the Dr Companion onto the wards as I would have nowhere to keep it safely during ward rounds etc. As such, unfortunately the Dr Companion spent most of the time in a cupboard at home." (*NCL Medical*)

However, some students overall felt that PDA and companion compendium were invaluable:

"I was able to look up anything i was unsure of during my rotations, using the Dr companion software and PDA. this was helpful as i was aware of a priceless tool available at my fingertips and when needed." (NCL Medical)

A proportion of the devices returned were damaged or had components missing (e.g. chargers, USB cables).

5.6 Staff/Faculty perspectives

5.6.1 NHS Librarians

Feedback by some NHS librarians highlighted two major issues which hindered use were related to NHS Trust information technology security and currency of information:

"The main problems within the Trust have been to do with the synchronization and problems with the internet settings on the PDAs. As a result, the students aren't using them much at all." (Medical Librarian)

Many of the resources (in particular, BNF, Clinical Evidence, Cochrane Abstracts, EBM, NICE guidelines and Oxford Handbooks) were considered potentially useful; however concerns were expressed about the currency of information when they lacked the ability to synchronise using the Trust internet settings. Currency of information was also raised by students:

"Used the Oxford handbook to look for vaccination details, unfortunately they were a bit out of date." (NCL Medical)

Other themes were similar to those identified by others, including the navigation and the anatomy resource:

"One of the main concerns is that the navigation isn't always obvious, we didn't think it was very intuitive to be honest." (NHS Librarian)

"We felt that the instant anatomy package looked a little bit homemade and thought that there might be a better product available…" (NHS Librarian)

In addition, users experience some technical issues.

5.6.2 Pharmacy Staff

The themes which emerged from the interviews with two members of pharmacy staff were similar to those identified by students. Both pharmacists used the PDA and Pharmacy Companion to support their work and one was hugely positive about the experience.

5.6.2.1 Teaching applications

The pharmacists reported their use of the technology in teaching students:

> *"Students I felt, it was useful for them in a slightly different way because if we saw a specific type of patient, say someone with alcoholic liver disease and you said 'this is a patient that's got this and what's the best management plan?' they used it as, they could use it as a teaching tool...Yeah so I thought that was quite useful to say 'look you've got all the information on your little device, go and have a look at it, see what you think and come back to me'. So it was quite good from that point of view" (Pharmacist)*

> *"I work with students and pre-regies and young pharmacists, they all need training of some sort so it's really useful so I would sometimes give my device to somebody and say 'well go and look it up and see what you think'. They're using it for junior doctor teaching as well, which is quite handy I felt. You know you can say 'look'; there was cases when, I think there was a cardiology ward where they were looking at beta-blockers and heart failure and I said 'well, what's the sort of cautions, contra-indication… go and have a look at it' so it's quite useful there" (Pharmacist)*

5.6.2.2 Student use

The pharmacists mentioned student use of the devices:

> *"they did have it in practice with them, they had found occasions when they did use it and did look up some things" (Pharmacist)*

> *"I think the students tended to like it on the whole, but I did find initially it was more of a novelty factor and it sort of wore off because in later stages of the project, near September when the software license ended, you know you saw them less and less" (Pharmacist)*

5.6.2.3 Portability

Portability and access to multiple resources was, once again, an important theme.

> *"A lot of the time when you're working in community pharmacy, you get queries… or you want to check… reactions or prescription details and it's find, yes ok, you can go and look up in the texts that are available but not every pharmacy has exactly the same texts. Most of them, you've got your BNF and in some pharmacies there's not a lot more than that…. it was really good to have that combination of books available" (Pharmacist)*

> *"as the role that I do is relief manager so I'm in a different branch every day, different pharmacy every day, or even two pharmacies in the same day, you can't be carrying*

round all those texts, you know, it's enough that you carry around a BNF but to have that access to all that information in that small container" (Pharmacist)

"to be honest I didn't think it was as useful as books…. But, saying that I can't carry all those text books with me so it did mean that I could do stuff in the wards where I would not necessarily be able to do on the wards in the past; I would have to go downstairs back to the pharmacy to get the reference sources. 'Cos that was really useful and you know there was times when doctors would come along and say 'oh could you just answer such 'n such a query' and I could sort of quickly get it so that was quite good." (Pharmacist)

The device proved useful as a substitute when Internet searching wasn't possible:

"you don't always have access to open internet, a lot of the companies have restricted internets/intranets but to actually just be able to look up what I wanted to without restricting the dispensing process…" (Pharmacist)

5.6.2.4 Usability

Usability was again mentioned, including comments about the screen size of the PDA, navigation and the time required to find information:

"One of the problems, I think it was, it started out being a bit of a problem, the navigation of it. Just the sort of the menus rather than, like you say… the I-pod apps and the books are in sort of drop down menus and we have to scroll down to read and stuff if you can read small print, some more application type style might be more readily accessible if you can see sort of all the texts on a page, but that did take a little bit of time and obviously if you're dealing with a patient or a doctor on the phone you want to try and make it as quick as possible so that didn't actually help, if it was a little bit speedier" (Pharmacist)

"I wasn't sure whether it was just the fact it was taking me a long time to find it or whether it was the retrieval from the memory device that was a bit slower. I think probably a little bit of both.... I certainly got faster at looking for things the more I used it but you were sort of rate limited by the processer" (Pharmacist)

The stylus also attracted negative comments:

'the only thing I didn't like about it was you had to use a little stylus, 'cos a lot of the touch devices have got a touch phone and you can use your finger now and that's so much better because the stylus thing you know, I kept putting it down and losing it and then I'd find it again but yeah it was a bit bothersome" (Pharmacist)

Compatibility with locked-down computers prevented syncing, although devices were seen as 'standalone'. Concerns were expressed about the lack of option to print from the device.

5.6.2.5 Familiarity and training

Familiarisation was seen by staff as essential:

"I didn't like it at first but certainly I think it's a much better way of keeping it and the longer I got to use it the better I was getting at it. Initially it was quicker to look in the paper copy" (Pharmacist)

Both pharmacists attended the student training session and found it useful in familiarising themselves with the device:

"you know roughly what they've got in, but a lot of that information isn't something that you would normally have. Therefore you, it's about learning what's available as much as how to get round it. How to navigate the applications. But to actually start using the PDA and using the program, the information from the CETL demonstration was really good and the worksheet, the handouts that they provided did take you through exactly what you had to do even down to sort of charging the battery and how long to do it for and what you needed to do in terms of the maintenance of it. That was good." (Pharmacist)

5.6.2.6 Cost

Concerns were raised about the potential loss of devices and related costs:

"I discussed this with some of my colleagues at work saying 'would we get these for our students, our pharmacists?' we had sort of a long discussion about it but felt probably not because what would probably happen was people would leave them around the place, lose them" *(Pharmacist)*

5.6.2.7 Relevance to the teaching environment

One of the pharmacists felt that the technology wasn't really required for the placement their students were on:

"I think it is because a lot of what the undergrads do on their placements is actually finding out how you work in a pharmacy so it's the day to day, the basics of it. How much involvement they would actually have in researching a query or something, they would, they are set tasks, they do have a planned workbook that they go through and some of that is… information queries that have to deal with, simulated ones. Saying that we knew they had a device like the PDA with pharmacy companion on, we would probably actually put in more strenuous workshop tasks for them so that they actually were stretched more. I certainly think that it may be of benefit to the final year students on the M [Masters] level in what they're doing in their workshops here to have that access." (Pharmacist)

"I think it's certainly of benefit to the undergraduates in the university setting when we're asking them for information on a quick basis. But it's all about I think how well they know what information they're looking for really" (Pharmacist)

Another comment implied that initially some of the resources seemed superfluous, however they proved useful with time:

"It covered much more than you would think you needed in community pharmacy but saying that I think through the summer, most of, I ended up looking in most of the books to find out information, to answer queries from patients or from other healthcare professionals, from nurses or doctors" (Pharmacist)

5.6.2.8 Potential long term use

One pharmacist discussed the idea of using the resource in future but decided against the PDA:

"I discussed this with some of my colleagues at work saying 'would we get these for our students, our pharmacists?' we had sort of a long discussion about it but felt probably not because what would probably happen was people would leave them around the place, lose them and they would just not, and we felt using the pc based solution was better where they can just access stuff (inaudible) computer on the ward as opposed to these things that you carry about yourself. So, given the choice of the PDA or something that is like a desktop or a laptop, but I'd go for the latter" (Pharmacist)

This may be due to concerns about screen size:

"if they had access to a laptop, pc I think they would much prefer that because it's a bigger screen for a start" (Pharmacist)

5.7 Other institutions' perspectives

These interviews were carried out to try to understand how other institutions were embedding such technology within their curricula, and also to explore whether there were any existing models that might work with the professional groups across the CETL4HealthNE. Interviews were conducted with staff in two external institutions who had used PDAs and some of the resources supplied on the Companion Compendium with their students; in both cases only medical students had access to the Companion compendium resources. These institutions had different licensing agreements with Medhand International, particularly as staff from one institution had been involved in the initial conception of Dr Companion and had worked closely with Medhand International, in particular with one of the Directors, since early 2000.

At the time of the interviews, both institutions supplied PDAs/smartphones to the students. From the interviews, it was clear that both institutions had different funding models, from that of the CETL4HealthNE, which was project funding, whereas these institutions accessed recurrent funding in order to be able to issue students with both the hardware and the software. Both institutions currently funded their initiatives by using SIFT (Service Increment for Teaching) monies to support the initiatives, although one of the institutions interviewed had originally used project funding for the initial phases.

One institution initially provided a list of PDA models (of varying cost), which would be supported by the institution, to the students, who then had to choose which device to purchase. The institution then supplied the Dr Companion suite free on loan to the students. Subsequently, they moved to a model whereby the institution provided both the hardware and software.

One of the institutions reported that the biggest concern raised by the students was "what if I lose it". They reported that only one student had reported losing the Companion Compendium card, so they had charged £20 for a new one. Also, because the devices were owned by the University and logged out to the students, if they failed to return the devices then this showed as an outstanding debt on their student record and they potentially wouldn't be permitted to graduate.

Two benefits they perceived of the SD card model (as opposed to using the internet to access resources) were that synchronisation did not have to occur whilst in the Trust setting (difficult to negotiate due to issues with NHS Firewalls), and the SD card was customisable, allowing inclusion of some of the standard materials normally only available via the VLE. Within one of the institutions, staff had begun looking at mobile education more broadly as opposed to piloting the use of specific learning resources. They also integrated the use of the PDA and resources into their teaching sessions, getting the students to work with the staff and use the PDA as a resource within evidence based teaching sessions and making the PDA an integral resource and learning tool.

The two external institutions had more structured functionality built into the use of the PDAs, such as using them for student assessment (in the clinical placement) or as a method of enabling data transfer from central University to the students, thus becoming bidirectional, which involved enabling of the Wi-Fi functionality. These institutions were also exploring using the PDAs and the Dr Companion suite with students in order to fulfil a gap that was felt to arise either in the placement setting or at home where there could be limited access to resources and to support the nature of clinical placements where just in time learning is often required. One of the institutions had conducted introductory sessions with clinical academic tutors and the NHS Trust to raise awareness of what was happening and what the students were doing, which included placing the onus on the student to ask the patient's permission to use the PDA in a consultation. Students' signed, and kept a copy of, a loan agreement which included information governance detailing what they were not allowed to store on the PDA/chip, for example Patient Identifiable Data (PID), and prohibiting access to the Wi-Fi in NHS Trust settings.

It was noted that one of the institutions visited had enabled their devices to be used on local NHS Trust Wi-Fi but in one case this had a time-consuming achievement having taken 3 ½ of a 4 ½ year programme to achieve, and had included discussions and visits with staff at all levels within the NHS Trusts. Despite the fact that these discussions had taken place at all levels including Chief Executive and Board level, some of the people in the practice setting still said that the students couldn't use their devices. Access to Wi-Fi meant that the students had the ability to synchronise the Companion compendium whilst in practice, however, a large number of them failed to do so. One of the institutions felt that the commercial aspects of the Companion compendium didn't work for them as, for the numbers of students involved, it was too costly. They felt that part of what was being paid for was the update or synchronisation facility – which wasn't being utilised by the majority of the students.

One institution reported initially very high usage of the Companion compendium, however, the overall feedback they received was mixed with some students expressing a preference

for traditional books, particularly as they expressed concern over battery failure of the device, whereas others had stopped using traditional books. The main resources used were the BNF and the Oxford Handbook of Clinical Evidence. Their resources also included Kumar and Clark's Clinical Medicine and whilst some of the students liked this resource the majority did not favour it. They also reported that the students had experienced issues around searching the Companion compendium as it didn't search in the way the students would have liked it to. Suitability of resources for stage of training was also discussed, with one institution reflecting that it was probably not much use in Phase 1 (years 1 and 2), but became more useful in Phases 2 (years 3 and 4) and 3 (year 5) with the opportunity for collections of resources to be suitably customised for the respective stage of training.

One institution who, in the future, were considering providing the Companion compendium to the students to access on their own devices (i.e. personal mobile phone) were intending to use some of the older devices they had previously used as a back-up for "what if situations" such as the student's own phone not being suitable to access the resources.

With regard to the hardware itself, one of the institutions reflected that the students had reportedly found the screen quite small and the keyboard as small and fiddly.

6. Discussion

6.1 Frequency of overall use

Across all the pilots, the only group of students who were asked about their frequency of use of the PDAs and Companion compendium resources was at Durham University. Most of these students used the PDAs and Companion compendium resources monthly, with only a low percentage reporting daily use. In one case, a student commented that "I have had it for months now and feel that it is wasted on me because I so seldom use it." PDA usage varies in the literature, with some reports of low usage (Smørdal and Gregory, 2003; De Groote and Doranski, 2004; Johnston *et al.*, 2004). Johnston *et al.* (2004)found that fourth year medical students used their PDAs less than once a week, and Smørdal and Gregory (2003) also reported poor utilisation of PDAs by medical students during GP and hospital attachments.

In contrast, George *et al.* (2010) found that 79% of their nursing students who were provided with PDAs used them 'at least weekly' and half reported daily use. On clinical days, PDAs were used 1-3 times by the majority of students and 7-10 times by a fifth of students. Miller *et al.* (2005) also reported frequent use, with 53% of nursing students using PDAs several times a week, 41% daily and only 5.6% of students once a week or less.

The relatively low use reported in the Durham University pilot is potentially explained by a number of the factors discussed below; in particular relating to the stage of training of the students (i.e. they have limited clinical opportunities).

6.1.1 Initial keenness

In all the pilots the students self-selected to have use of these resources, however, in some cases it appears that this was the novelty factor: "My opinion so far is that my PDA is (or was) a novelty". Smørdal and Gregory (2003) reported that students were keen to use PDAs and from the numbers self-selecting from within our pilots we would support this finding.

6.2 Resources (including usage, availability and update frequency)

With regard to the pilots, the resources were customised by discipline so it is not possible to compare like for like resource usage. Despite this, the BNF was used very frequently by all student groups. Both Durham University medical students and the nursing students reported high use of the medical dictionary. Reported use of other resources varied across student disciplines. Resource usage by medical students from both Durham and Newcastle Universities differed slightly. This was particularly with respect to the Durham students, who were in year 2 of their degree and were mainly campus-based, as opposed to the Newcastle students, who were final year students based in clinical settings on various rotations. Durham University medical students frequently used the Oxford Handbook of Clinical Medicine and Instant Pictorial Anatomy. Use of the latter may reflect the intensive anatomy component in their curriculum. It had been hoped that these students would have access to Netter's Atlas of Human Anatomy. However, this only became available in the later stages of the pilot to some of the other professional groups, when it was used by many nursing students. Other reported variations in usage between Durham University cohorts may be due to the wide variety of student projects available on diverse topics (Student Selected Components and community placements).

Similar to the Durham University medical students, both Newcastle University and James Cook medical students predominantly used the Oxford Handbook of Clinical Medicine, but also the Oxford Handbook of Clinical Specialities. These differences probably arise from the different curricula, rotations and stages of the students.

In line with the findings of the pilots, the resources that were predominantly rated highest in the literature were clinical references (Speedie *et al.*, 2001), drug guides, medication resources and medical dictionaries (Miller *et al.*, 2005; George *et al.*, 2010). Whilst the students in the study by Brock *et al.* (2003) most frequently used a drug reference, clinical and infectious disease resources and a clinical calculator, and rated satisfaction with these highly. Out of all the literature reviewed, only one study, by Johnston *et al.* (2004), found that of all the resources available, the prescription/drug information was the least useful, whilst in their study, the students rated the Cochrane reviews as the most useful.

A vast number of resources and reference materials in the field of healthcare education are available for different portable devices, ranging from free and demonstration versions of software, to fully functioning higher cost resources (George and Davidson, 2005). One important factor to consider when purchasing these resources is the update frequency (George and Davidson, 2005). This is something that was raised as a concern by the NHS librarians in our pilot, who had concerns that if the Companion Compendium was used as a stand-alone resource and was not synchronised, then the resources within the Companion Compendium could become out of date very quickly. However, in our institutional interviews, it was reported that despite having WiFi access which allowed synchronisation many students did not avail themselves of this opportunity. Interestingly, in much of the literature, the resources available via PDAs are seen as being more up to date than textbooks, with text books being perceived as being outdated (George and Davidson, 2005). Students within our pilot also reflected this: “If I had not used the Dr Companion I would have had to spend a long time trawling through a literature search or would have had to settle for using an out of date textbook.” However, a couple of students perceived some of the texts to be out of date, having used the Companion Compendium to look for vaccination details, “unfortunately they were a bit out of date”.

6.3 Themes

Although the pilots within this project spanned across multiple disciplines and sites, there were two main common themes that were identified through the findings; these are:

- Usage: how the resources were used to support learning and
- Factors influencing the use of the technology.

6.3.1 Usage: how the resources were used to support learning

6.3.1.1 Mobile learning; travelling; anytime, anywhere access

From the findings, one of the key themes was the students’ ability to access resources and learning wherever they happened to be. This is supported by the literature in that Brubaker *et al.* (2009, p. 390) found convenience to be an emerging theme: “The students reported that the PDAs were very convenient for seeking information, not only in the clinical setting, but anytime, anywhere, 24/7.” These findings were also supported by Goldsworthy *et al.*

(2006) and Carlton *et al.* (2007), and also White *et al.* (2005, p. 153), who found that students used the devices whilst "waiting for meetings to start or on the shuttle bus". Medical students at the University of Leeds (Davies, 2012) described using smartphones to make more effective use of their free time (e.g. by looking up and locating information). In our pilot, students found the portability of the device valuable; "An easy way to…. read lecture notes, e.g. whilst on bus" and another student reported that they found it useful whilst living on site away from easily accessible library facilities, "it was useful to have this as a resource" and another student commented that "I can have a look at anatomy on trains etc and looking up drugs and using the dictionary." This is supported by Speedie *et al.* (2001) who reported that students found access to resources which aren't otherwise available whilst on a family medicine clerkship useful, as they were geographically dispersed.

6.3.1.2 Practice/Clinical encounters including supporting, preparation, retrieving information, diagnosis, investigations, treatment, Patient education and note taking

Of the three professional groups of students, the medicine and nursing students reported using the PDA and associated resources to support practice/clinical encounters more than the pharmacy students. This may have been due to the nature of the placements and, in the case of pharmacy, more limited contact with patients. The majority of the reported usage of resources was around retrieving information, where the student was unsure and used the resource to clarify knowledge, using the resources to understand procedures and events. This is supported in the literature by George *et al.* (2010, p. 374) who found that "80% of students indicated that the PDAs were used for educational purposes as reference devices". They also found that almost all students used their PDAs for clinical purposes, two thirds in the classroom and just over half for personal use.

Stroud *et al.* (2005, p. 70) found that students used "…a PDA for assistance in clinical decision making", and this is mirrored by students in this pilot: "I used them as I was caring for patients, if I did not understand or needed to know a specific detail I would look them up, particularly in those that gave me details of drugs or anatomy and physiology". Stroud *et al.* (2005, p. 72) also found that "96% agreed that the PDA had supported their learning and/or clinical practice". The type of reported usage by the students regarding diagnosis, investigation and treatment is in line with the findings reported by Brock *et al.* (2003), Scordo (2003), Altmann and Brady (2005), Honeybourne *et al.* (2006) and Koeniger-Donohue (2008). The immediate access to information supported the students in our pilots in order to "justify investigations to perform and their significance", as well as finding the resources "useful for looking up conditions and their management quickly in surgery. The University of Leeds (Davies, 2012) reported that their 4th and 5th year medical students with iPhones felt that these supported clarification of conditions and diagnosis when working with clinicians. This was reinforced by clinicians involved in their undergraduate teaching, particularly as they felt that students would look up clinical information there and then rather than do it at a later time, and that access to resources was better/faster via mobile devices rather than hospital IT systems.

Some of the students within the pilots also reported having used the PDA and resources as a tool for patient education and "to help patients understand and pictures for them to see"; this is in line with the findings by Honeybourne *et al.* (2006). Koeniger-Donohue (2008, p. 76) also found that students used the PDAs with patients in order to review medication side-

effects and when discussing them with a patient "she did not know, so I got out the PDA, and in 2 seconds it was there!". Honeybourne *et al.* (2006, p. 58) also reported that participants were "more definite about the benefits of hand-held resources in answering specific patient queries immediately." However, some of the students within our pilots reported feeling uncomfortable using the devices in front of patients. This reflects the findings from the University of Leeds (Davies, 2012), where students also reported feeling uncomfortable and the clinicians felt that an "etiquette" was required when using the devices around patients, they had responded to this by writing an "etiquette document" which was distributed with the PDAs.

Some students also used the PDAs as method of keeping up to date notes: "storing immediate experiences following clinical encounters as a learning portfolio tool" and "I found it useful on my community placement for taking notes on the PDA Word". Turner *et al.* (2005) found that some clinicians used the PDAs in order to dictate letters and take notes.

6.3.1.3 Taught Sessions

In our pilots some students reported using the PDA and Companion Compendium to support taught sessions in order to clarify meanings and terminology as found by Goldsworthy *et al.* (2006) and George *et al.* (2010) However, some students identified them as a distraction. This is supported by Speedie *et al.* (2001) who reported that the most asked for feature for the PDAs was games, and many devices were returned with games installed.

6.3.1.4 Self-directed learning and revision

Some of the students reported using the Companion compendium to support their independent learning and revision: "I used the BNF, The Oxford Handbook of Clinical Medicine and the Oxford Handbook of Clinical Specialities for self directed study, for example, completing the study packs during spare time on the primary care rotation." and "I used Dr Companion for the BNF and Oxford Handbook of Clinical Specialities during self directed study, as it was faster than looking through the relevant paper books". Brubaker *et al.* (2009) found that students used the PDA to revise prior to exams as well as using the device to complete assignments. Kuiper (2008) reported that after usage on the clinical unit, the students used the devices mostly at home on a weekend, thus suggesting that they were being used to support their studies.

6.3.1.5 Facilitating organisation

Of our pilots, the Durham University students were the only group who were asked about the use of organisational features of PDAs, such as email, notes, calendar and address book, to support their learning. However, one Newcastle University student did comment on the usefulness of being to take their timetable with them on the PDA, as well as "recording important dates for when I needed to see patients and important deadlines for the submission of different work as part of the rotations" (NCL Medical). These students generally reported that the calendar was useful and this is supported by Johnston *et al.* (2004) and Brock *et al.* (2003). Some students had used the PDA for email, but this had been via public and home wireless networks as the PDAs were not compatible with University wireless networks and were not approved for use on NHS wireless networks. There is not much evidence in the literature of students using this facility, reported usage is

predominantly around clinicians and academics, however, Brock and Smith (2007) did report one student out of thirty five having used this facility.

6.3.2 Factors influencing use

6.3.2.1 Usability, including ease/difficulty of use

George *et al.* (2010) noted that ease of use was the most important factor influencing use of PDAs, followed by use by peers and curriculum requirement. In our study, different students found the PDAs either easy or difficult to use with some students finding that the PDA was easier and more efficient than the equivalent textbooks: "If the pharmacist asked me to look something up I was able to find it more efficiently when using the PDA" and "faster to find drugs than in paper BNF". Brock *et al.* (2003, p. 14) also found that "students believed that PDAs made accessing information easier (94%) and quicker (79%) than traditional resources". However, in contrast to this, some students in the pilots found that the PDA's were: "slower than a book to access information. E.g.: where hard copies of the book like the BNF are widely available on wards". This is in line with the findings by Johnston *et al.* (2004) and Miller *et al.* (2005).

When the initial pilots were undertaken, the DocSearch Tool only searched on a text-by-text basis as opposed to across the full companion resources, and consequently students found this frustrating and time consuming, and their feedback was that it "Needs a better indexing system". Similarily, Honeybourne *et al.* (2006, p. 57) reported that participants found the Oxford handbooks "impossible to search" and "Difficult to access and read". However, during the pilots, updates to the DocSearch Tool allowed searching across all collections, and students expressed greater satisfaction with this: "the search engine facility was most useful in this example as it allowed for a quick overview of information from all of the sources to be collated rapidly". Particularly some of the students perceived this as saving them time: "Dr Companion to help me write my notes and use the DocTool search to quickly find the information I needed without travelling through several chapters." Some students also commented that the searching facility was "more efficient compared to looking through paper copies of the books, it made it easier to find the relevant information, without having to search manually through several different books".

Despite improved searching, navigation and scrolling were still an issue and some students either didn't use the PDA: "I used it for looking up certain disease; however I did not use it as much as I found it difficult to navigate", or found it time consuming.

Shaikh (2004), in agreement with these results, identified that "ease of navigation" of electronic documents influenced the decision to read virtually and found that "users also included too much scrolling as a downside to reading online." Miller *et al.* (2005) found similar issues with "fatal errors" relating to small screen size and scrolling.

Another issue was that the PDA was used with a stylus and some students found this an issue:

"Tapping with a stick, slow at typing words out, screen 'frozen' sometimes which was frustrating."

6.3.2.2 Portability, links with anytime anywhere usage

There was mixed feedback regarding the portability of the devices. However, a number of students commented positively on having "Information available in the palm of your hand", and some found them both portable and useful with regard to using them at any time.

Greenberg (2004, p. 571) reported that students appreciated "having fewer books to carry". However, many of the medical students participating in the pilot at James Cook University Hospital complained that it was difficult to fit the PDA into their pocket. This was also reported by Miller *et al.* (2005, p. 25), who found that some nursing students found them too bulky to "carry them in their pockets". This, in effect, meant that some students failed to make use of the resources at all within the clinical setting.

6.3.2.3 Battery life/failure

Battery life is a recurrent theme in the literature (Carlton *et al.*, 2007; Brubaker *et al.*, 2009; Zurmehly, 2010) and, although some of the reported studies relate to older models of PDAs, this was a problem within our pilots too: "the battery life was very poor and often when the PDA would have proved useful it was out of power". George and Davidson (2005) found that battery life was a key feature when selecting which PDA to purchase. We also found that the students reported that the PDA froze and effectively crashed; this was also found to be an issue by Speedie *et al.* (2001) and Miller *et al.* (2005).

6.3.2.4 PDA properties including screen, resolution and size

Screen size and resolution was a recurring theme and many students commented negatively on both the size and resolution of the screen: "The screen on the PDA is too small to make it a practical alternative to a textbook for me" and "writing was often very small or maladapted for the size of the screen". This is in-line with the findings of Scordo (2003, p. 351), who reported that the "screens are small and can be difficult for some nurses to read". George and Davidson (2005) suggested that the relative importance of portability versus screen size is an important consideration for a PDA. The PDAs that were used in our pilots when purchased had the largest screen size that was available; this was reported as being too small by many of the students. Small screen size was also an issue identified by students in the study by Miller *et al.* (2005) and by one of the institutions we interviewed. In addition, survey results identified a need to reformat documents to improve on-screen readability. George and Davidson (2005) also discussed screen size and quality (resolution); however they also point out that better screens cost more (Neely and Sittig, 2002).

6.3.2.5 Number of resources

Students in the pilots found it was valuable to have access to multiple references: "It was useful to have a variety of books available within one device". However, some commented that the resources on the PDA were not appropriate for their level at the point of issue; "I feel I would benefit from more science based books on the PDA at this moment in time, rather than the wide range of Clinical books on it." This is something that was addressed as the pilot was extended and it became possible to customise the collection of resources for both the stage of study and the relevant professional group.

There was also feedback from students who felt that the resources could have been expanded to have included more texts for them, however, this may not be possible as Medhand International, at that point in time might not have had access to licences for some of the requested books. One book that was requested frequently at the start of the pilot, and was promised as being a resource that would be available soon, was Netter's Anatomy; this was available at the later stages of the pilot to some of the groups of students. The feedback about the instant pictorial anatomy was that it was not to a high enough standard and the NHS Librarians commented that "We felt that the instant anatomy package looked a little bit homemade and thought that there might be a better product available."

6.3.2.6 Issues and Personal Preferences

6.3.2.6.1 Preference for books (Student preference)

An emerging issue that threaded through the feedback across the pilots was the preference of some students for books as opposed to the PDA and Companion resources. This was particularly around the speed of access and personal preference: "I did not use my doctor companion kit as I prefer to read from textbooks." This apparent favouring of print books over electronic documents is in agreement with the literature (Ramirez and Gyeszly, 2001; Bodomo *et al.*, 2003; Langston, 2003; Torre and Wright, 2003; Shaikh, 2004; Perry, 2005). Many early studies attributed this predilection to usability issues, including eye fatigue and inability to digitally highlight, annotate and bookmark texts (Bodomo *et al.*, 2003; Annand, 2008). However, as Ackermann and Goldsmith (2011) points out, despite advances in screen technologies (including the ability to highlight, annotate and bookmark), people continue to express preference to read from print (Ramirez and Gyeszly, 2001; Bodomo *et al.*, 2003; Langston, 2003; Shaikh, 2004; Perry, 2005; Annand, 2008).

A number of students in our pilots reported finding the PDA unsuitable for reading large quantities of text. Likewise, Abdullah and Gibb (2008) found that users expressed preference for digital texts, such as ebooks, for reference purposes, and print material, such as books, for lengthy episodes of reading. Similarly, Sottong (2001) suggests that books used for reference purposes are useful as ebooks, for example, encyclopaedias, manuals and handbooks. Shaikh (2004) also reported that individual preference to read online or from print depends on the type of information, its size, importance and purpose.

Printing digital material in order to read is reported by numerous authors (Shaikh, 2004; Perry, 2005; Annand, 2008). Perry (2005, p. 4) stated that "many students expressed their dislike of reading from a computer screen and a number said that they generally printed things out if they needed to read large amounts of text from electronic sources". Shaikh (2004, p. 3) found that only 20.3% of study participants read academic/journal articles online while "70.4% reported printing the document", and almost half said they would "scan online first, then print to read on paper in more detail."

Students in the pilots commented on the inability to print from the devices, suggesting that they would rather read from print. One Durham student printed from the Companion chip by using it in her laptop: "when learning anatomy, I kept confusing the various forearm muscles so I used the Dr Companion on my laptop to print out giant versions of the pictures showing the muscles! It cost me a fortune in ink, but I remembered them!". The indication

here is that this student found these images easier to view in print than on the PDA or laptop.

6.3.2.6.2 Technophobia

The self-perception of being a technophobe meant that some students didn't try to get used to using the PDA or accessing the Companion compendium as they "presumed it would be too difficult for me to use, and did not try hard enough to get to grips with it". George and Davidson (2005) also reported that student "hesitancy was related to lack of general technology preparedness; several students had minimal computer skills leading them to be afraid of yet another form of technology" and later (George *et al.*, 2010) described "discomfort with technology" as a barrier to PDA use for a small proportion of nursing students. This was also an issue for students in the study by Johnston *et al.* (2004); they reported that the perceived usefulness of the PDA was correlated with a number of factors including the self-perceived computer literacy skills of the student.

6.3.2.6.3 Familiarity

Across the pilots, prior experience of using PDAs was low, ranging from zero to seventeen per cent of students. Thus, the majority of students were not familiar with these devices. Those who had previously used PDAs were not questioned about the context of past use, which may not have been in an educational or clinical context, or the make and model of PDA, making it difficult to gauge their initial familiarity. A number of students commented on their lack of familiarity with this technology.

Greenberg (2004) observed a progressive increase in access to resources and a decrease in time spent using each resource throughout their study, and suggested that students become more familiar, and thus require less time to find the material they are looking for. This was seen in our study by students finding use hard at first: "Had difficulty at first accessing some of the programs and getting around the PDA device itself." However, students recognised that it would become easier with practice: "It is difficult to find the information needed, whether with more experience using the PDA this would improve, I find it easier and quicker to locate information from textbooks."

George *et al.* (2010) mention that consideration must be given to the added time required to learn how to use a device. In an earlier study, George and Davidson (2005) found that many nursing students "expressed frustration with learning how to use something else that was new". Frustration was observed in these pilots and drove students to use more familiar resources: "I think the main problem I had with it was a lack of familiarity so my immediate reaction was to look information up in books." This is similar to findings by Gallis and Kasbo (2002), who reported the conflict between learning how to use a new device versus the familiarity of traditional mechanisms such as books.

Bodomo *et al.* (2003) identified habit as one of the factors influencing the use of print books versus ebooks. George and Davidson (2005) attempted to overcome this by providing PDAs to nursing students one semester before they were required to use them in clinical placements, allowing students the opportunity to become familiar with the use of the device and software. Likewise, in the study by Miller *et al.* (2005), nursing students were asked to use their PDAs for a number of in-class tasks prior to their clinical rotation. They

also asked students to "view the PDA as they would a stethoscope, required to be with them, not stored in a locker" (Miller *et al.*, 2005, p. 22). This approach may have reduced students in the pilots reported here forgetting to take ("Not taking the PDA with me"), or use, the PDA. As one student said, it was "Difficult to get used to using it, i.e. making it a habit." Brock *et al.* (2003) showed that Physician Assistant students who used their PDA frequently for clinical purposes also used them frequently for educational benefit, indicating that familiarity increases use across contexts. One student within our pilots reflected "the PDA has been an invaluable tool, and I would consider using it again in the future. It took me a while to get used to it, so I struggled to find the information I needed quickly initially." This highlights how familiarity has increased with usage to the point that they saw it as "invaluable".

Familiarity can also be an issue for tutors. Johnston *et al.* (2004) perceived that the usefulness of the PDA was correlated with support from tutors and this was an "important barrier to utilisation". George and Davidson (2005) describe "faculty integration of PDA technology" as "challenging", and suggest workshops and other training and support. They provided PDAs to tutors in advance, allowing them the opportunity to become familiar with the technology before students received their devices. Miller *et al.* (2005) did not provide faculty with PDAs and found that this may have reduced the chances of faculty encouraging student use of PDAs as they were not familiar with the devices. Faculty members suggested that they could act as role models (as they observed increased student use when faculty used the devices), provide help to students and increase PDA use in the course if they had their own PDAs. Staff members spoke of the 'learning curve' experienced by all PDA users, with familiarity increasing comfort. Lack of familiarity of clinical staff and tutors may also become an increasing issue if students can choose any device which is compatible with the required resources (George and Davidson, 2005). Although PDAs and the Companion Compendium were issued to mentors in nursing and pharmacy, within this pilot we were unable to get any feedback from the nursing mentors.

6.3.2.6.4 Training and Support

Training was an issue that arose in nearly every article in the literature . Some students in the pilots suggested that additional training would have been good. The training that was available was variable across the different pilots with access to standardised materials and training by the CETL4HealthNE technicians. There was also the offer of technical support via a generic email address and the mobile telephone number for the CETL4HealthNE technicians. In most cases, there was no additional support from the students' institution or their placement apart from Durham University. In the majority of the PDA pilots, leads from the clinical area also attended the training, using clinical examples and questions for the students to answer using the PDAs. George *et al.* (2010) found that nursing students identified a lack of training and support as a barrier to their use of the PDAs despite dedicated support being available; 14% of their students were dissatisfied with this support.

In our pilots all students were given a training guide for use that included information on how to use the resources with a laptop or desktop computer. It had been anticipated that there would be a lot of support required for these pilots, however, the greatest drain on time was the setting up of the PDA's, ensuring they were fully charged and had all their

component parts. This is supported by Miller *et al.* (2005)), who reported a significant amount of preparation time in setting up PDAs before distribution to students.

De Groote and Doranski (2004) stated that training needs of healthcare providers "varied by department" and they highlighted the importance of tailoring training to the requirements of users. They also discussed the need for subject librarians to be involved in supporting the use of PDA resources. This is one area that within our pilots we did not explore to the full potential.

6.3.2.6.5 Disability

Some students raised the issue of disability relating to poor eyesight and dyslexia this was an area that had been explored, in particular relating to dyslexia, with the Assistive Technologies Unit at Newcastle University. The query they had was about using the resources on a laptop computer with standard assistive technology programs that support students with Dyslexia. They had contacted Medhand International to ask if it was possible to adjust the settings so that the readers could function properly, but received no response. One student had asked on the questionnaire about adapting the resources for people with Dyslexia.

6.3.2.7 Acceptance in Clinical/Placement Setting

6.3.2.7.1 Acceptance by NHS staff and patients

When allocating the PDA resource to students, all NHS practice settings and practice placement facilitators were contacted to let them know that students had the PDA for use within the clinical setting. In one particular case, prior to allowing the students access to the resource, meetings were set up with Clinical Governance in a Trust, and the Practice Placement Facilitators and Mentors were also issued with PDAs for them to use, and to provide feedback. Interestingly, the students who raised concerns about using the PDAs in clinical placements were in locations where the more in depth discussions and access to the devices for staff had taken place:

> "Staff at some placements were not happy about the use of them as they looked like mobile phones even after reassuring them that they were for academic use and were actually hand held computers."

One of the institutions we interviewed experienced similar issues where despite extensive discussions with Chief Executives and the Board, students met with resistance in the clinical setting when attempting to use the devices.

Some students commented on not feeling comfortable in using the devices in front of patients although others had used them as a patient education tool: "Sometimes seemed inappropriate to use it in front of patients". As highlighted by Brock *et al.* (2003, p. 13), p13) "it is unclear whether patients respond positively to the use of PDAs in their encounters." However, they go on to state (p14) that in their study that "students reported that patients generally responded positively to their use of handhelds (66% positive)". Some students commented that they felt that using the PDA and Companion Compendium was "less

obtrusive to the consultation (thereby perhaps looking more professional to the patients concerned) than looking through paper copies of the books would be."

6.3.2.7.2 Infection control

Concern about the potential for contamination of the PDAs was raised by a small proportion of students. Although the evidence for transfer of micro-organisms from environmental surfaces, via healthcare workers, to patients and the subsequent development of nosocomial infections is variable (Hota, 2004), PDAs *may* act as a reservoir for the transmission of microbes, including antibiotic resistant strains. George and Davidson (2005) discussed concerns about contamination of PDAs in clinical environments. Neely and Sittig (2002) review examined the potential of inanimate objects, such as computer hardware, to become reservoirs for micro-organisms resulting in nosocomial infections. Computer keyboards are associated with patient infections. Only one student in the pilots reported that they had disinfected their PDA. Despite published decontamination advice and evidence of its effectiveness, Morris *et al.* (2012) found in their study that this remains an issue, and in their letter in the BMJ, Osborne *et al.* (2012) reiterate the suggestion that hand-held devices should be fitted with wipe-clean covers to aid disinfection. Ultimately, training and guidance is required to ensure best practice.

6.3.2.7.3 Internet access

In all the pilots we conducted, the only way that the students were allowed to use the devices in the practice setting, was with the wireless internet disabled. However, Smørdal and Gregory (2003) reported that within their study, wireless internet access was available via PDAs in hospitals. Many of the students across our pilots would have appreciated this facility. Of the institutions that we interviewed one allowed wireless internet access in the NHS Trust in order to facilitate synchronisation and two-way communication whereas the other institution at that point in time did not. It should be noted that this had been an onerous and time-consuming achievement.

6.3.2.8 Cost and damage

A number of factors relating to cost are discussed in the literature, and also came to light in this project:

- Cost of the device versus the available features (e.g. screen size, memory, battery life etc.)
- Cost of software, e.g. reference resources
- Cost to the programme versus the students
- Technical support
- Damages, theft and insurance
- Student fees

George and Davidson (2005) mentioned making decisions based around the cost of PDAs in relation to features, and suggested that choices should be based upon the functionality required to meet the desired usage. In their later study, George *et al.* (2010) highlighted the important consideration of the cost of both the technology and technical support for integration of mobile technologies into curricula. George *et al.* (2010) also found that nearly

half of their students experienced barriers to use of their PDAs, with technical issues causing the most difficulty.

Different purchasing models have been utilised, with some healthcare programmes providing devices and resources free to students, others requiring students to meet all costs, and others splitting the financial burden. George and Davidson (2005) provided students with PDAs, but required them to purchase software, although the cost was spread across the academic year. George *et al.* (2010) required their students to purchase a book in addition to freely provided resources. As part of their study, Miller *et al.* (2005) required their accelerated baccalaureate nursing degree students to purchase a specified PDA and software. During our institutional interviews, we discovered that one of the institutions had initially required students to buy PDAs and had loaned the Dr Companion resources; subsequently they changed to a model where the institution supplied both the device and resources. However, at the time of the interview they were exploring the option of the student using their own devices (e.g. smartphones) whilst the institution supplied the resources. The other institution supplied devices and Dr Companion resources. Both had utilised SIFT monies to fund these initiatives. In the study reported here, devices and software were provided without cost to the students; however it was only ever a short-term project. Some of the literature suggests that it is possible to negotiate the cost of hardware and software when purchasing in bulk (George and Davidson, 2005).

Some of the students in the pilots also expressed concern at being responsible for the PDAs and were worried about damaging or losing them, resulting in some cases in either no use or wanting to hand the devices back: “the main barrier was that I was scared to lose it!” Brock *et al.* (2003, p. 14) reported that students in their study had expressed concerns regarding “the risk that the PDA might be lost or stolen”. Miller *et al.* (2005) also noted that students voiced fears about theft of the PDAs and desired a cheaper model. From the institutional interviews conducted, students had conveyed apprehension about losing the device; as a consequence, that institution developed a policy with minimum financial impact to the student.

Over all of the pilots, only two PDAs were lost and on one occasion only the Companion compendium SD-Card, although a proportion of the devices returned at the end were damaged or had chargers and USB cables missing. This is in agreement with the low levels of damage to and failure of PDAs reported by Speedie *et al.* (2001).

6.3.2.9 Relevance to the stage of training and embededness in the curriculum

Across all of the pilots in this report, the most significant advantages of having access to the PDA and Companion Compendium were reported by the final year medical students at Newcastle. These students reported the usefulness of having the resources available to them that allowed them to make use of small amounts of free time whilst in clinical practice, “saved me lots of time and allowed me to prepare during free time whilst on the wards”. The final year medical students commented on the usefulness of being able to do preparation and consolidation whilst in the clinical setting as well as the availability of instant answers via the Companion Compendium. This is echoed by Greenberg (2004, p. 571) who noted that third year medical students “felt that the PDAs were useful during their clinical rotations.”

Interestingly some of the students within the Durham pilot reported that they felt they could see the benefit for when they were in clinical practice, but not at their stage in the curriculum, and some reported that they felt that they could not put the resources to best use. Johnston *et al.* (2004) highlighted the importance of tailoring resources to the requirements and level of students – which is reflected by the Durham pilots. Some of the Durham students felt that the resources provided, for example the Oxford Handbooks on Clinical Specialities were not relevant for them at the stage of training they were at. This was supported by one of the institutions interviewed and by Smørdal and Gregory (2003) who also recognised that the resources they provided were not appropriate for their students.

George and Davidson (2005), in their list of considerations for implementing PDAs in nursing curricula, stressed the importance of focussing on how the devices will be used. They specifically chose each software package with a purpose in mind. This is in contrast to some pilots within this study, where Companion compendium resources which were not all appropriate for the level of study.

6.3.2.10 Time Pressure

Speedie *et al.* (2001) found that use of the PDA, for both information retrieval and logging, was dependent on time pressures. When there were many patients to be seen students did not have time to use the PDAs, and logging was performed when not in the patient setting. This is reflected in some of our pilots, mainly with the Durham medical students, nursing and pharmacy who felt that there was insufficient time in the practice setting to use the resources. However, the Newcastle medical students commented that the Companion Compendium enabled them to make more effective use of time.

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7. Recommendations

It is essential that the use of technology is part of a blended approach within teaching and learning and is not just added on as "something that should be done". This is in line with Recommendation 5d in the DH TEL Framework Department of Health (2011, p. 28) "Simulation, e-learning and new technologies should not be used as an end in themselves, but appropriately integrated in a blended approach to learning and implemented to address specific learning or clinical needs."

From all the pilots and from the literature, it is very clear, that successful integration of mobile technology into the curriculum needs to be embedded as a core part of how the students are both taught and how they support themselves as learners.

Engagement with Faculty is crucial to ensure acceptance and appropriate role modelling of use, and understanding how mobile technology and associated resources can support learning, particularly in the clinical setting and can be embedded into the curriculum.

Providing PDAs is not economically sustainable in today's financial climate, particularly with the speed and change of technology, and as many students have access to their own smartphones.

An opportunity to provide guidance to students as to how they can use the technology that they have to support their learning (including data protection and patient confidentiality and minimising contamination) may be more appropriate.

Where on-line/electronic resources are to be mainstreamed, alternative hardware must be considered for students who might not own mobile devices.

Faculty should consider ways of providing pointers to resources as an alternative to purchasing Companion Compendium; there are many resources on-line and accessible through University Libraries that have no, or little, cost implications. For example, the BNF is now available as a free 'App' for medical practitioners to use on mobile devices (via their Athens account).

If additional resources, such as the Companion Compendium, are to be provided/recommended to students, then careful consideration of which resources are provided/recommended and how they link in to the level of study is required. From our pilots, it would have been beneficial to have customised the resources at an earlier stage, for example the Durham Students needed different resources to the Newcastle Students – which is a reflection of where they are within the degree programme.

Provision of Wi-Fi internet access in clinical placements is essential to make the most use of mobile devices, especially if they will be used for workplace-based assessment or for portfolios.

8. Conclusion

Technology advances rapidly, and although there is much guidance in the literature regarding considerations when purchasing hardware for use by students to support learning, we conclude that such purchases of PDAs are now outmoded as these have now been replaced by smartphones and tablets. From the CETL4HealthNE pilots, excluding Durham University pilots, the PDA was very much seen as a means to an end – this being the necessary technology to provide the students with the resources and the CETL4HealthNE was more interested in how the students used the resources, rather than additional functionality of the PDA. Obviously, usage of the resources was affected by the PDA, as perceived issues with the PDA affected how and when the students would attempt to engage with and use the resources. As outlined in our findings, many of the factors influencing use were related to the PDA with regard to usability, portability, battery life, screen resolution and size and other PDA properties and linked to student circumstances such as disability, technophobia, familiarity, and preferences, e.g. reading on screen. There are a number of considerations when contemplating the use of mobile technologies to enhance and support the learning of health care students and practitioners. George and Davidson (2005) listed 6 questions to be considered when incorporating PDAs into a Nursing Program, some of which relate specifically to the hardware, but their other questions remain valid, in terms of incorporating technology into the curriculum and we suggest should be amended as below for institutions considering how to incorporate mobile learning into the curriculum:

1. What are the best software programs for mobile technology to support student learning?
2. Can students replace required textbooks with mobile software and applications?
3. What is the best way to integrate mobile technology use among the faculty?

Although some questions have changed focus slightly to concentrate on mobile technology as opposed to PDAs specifically, due to advances in technology, the same concerns and considerations remain, and are applicable for all healthcare curricula.

Since the advent of smartphones, the question of which operating system no longer remains Palm OS vs Pocket PC, but becomes iOS vs Android vs Blackberry vs Windows and others. George and Davidson (2005) discuss the availability of healthcare PDA software for each operating system, and a parallel exists with software (or applications, commonly referred to as Apps) available today. Whilst many Apps are available across the most common platforms, some are only available, at least initially, on iOS or Android. This also has implications for creation of 'in-house' material which is tailored to the curriculum. Should material be created which will function on all devices? Companies supplying resources now provide them in multiple formats, enabling resources to be used on devices running iOS, Android, Microsoft Windows based operating systems etc – this has both opened up the market, and increased the potential opportunities for resources to be accessed by the majority. In a recent survey at Imperial College London, approximately 42% of the medical student population owned an iPhone or iPod Touch ((Toro-Troconis *et al.*, 2012)) – many students now own smartphones in one form or another, making the provision of PDAs

defunct. This was reflected in the interview which was carried out with one of the institutions who supplied PDAs and Dr Companion resources to their medical students. When interviewed, they predicted that in 2 to 4 years their institution would only be looking at providing resources (and not devices) due to the development of smart phones. They envisaged merging of PDA and smart phone functionality and that the data would be pervasive – a situation that is virtually true now.

This pilot allowed us to trial the use of PDAs across a number of pre-registration healthcare programmes, but in terms of sustainability, this would not be sustainable for the numbers within the programmes and also the technological support requirements. From the interviews carried out with staff at external institutions, it was clear that such use of technology had been embedded into the medical curricula, which has allowed them to access SIFT funds to help support this. However, SIFT funding is only available to Medical Schools and this source of funding would not be available to other pre-registration healthcare programmes. From the CETL4HealthNE pilots, the costs in terms of hardware, software and technical support would prove to be too costly for continuing such an initiative. Interestingly, when the PDAs and resources were distributed to students, it was explained that they had been purchased from CETL4HealthNE which was a HEFCE funded initiative and that none of the resources directed towards their course or NHS had been used. However, a number of concerns were raised about the cost of the equipment and the University allocation of resources from fee income: “the money that this would entail could be either better spent on us, or on staff or on the NHS”.

From the interviews with staff in two external institutions, it was clear that the use of the PDA and resources was embedded within the curricula and although, originally these may have been piloted, in order for such technology to be supported and rolled out over a whole programme it was essential such resources were embedded and valued by both Faculty and students. Within the pilots reported on here, in most cases it was simply seen as an opportunity to trial the resources, and although it was seen as an opportunity for the students from Faculty, it was not something that they wholeheartedly engaged with and wasn’t seen as a priority. This is in line with recommendations by Zurmehly (2010, p. 180) who found that “Active involvement on the part of faculty and students is key to the successful integration of PDAs in the classroom and clinical setting.”

The main benefits that the students perceived about the use of the PDAs and the Companion compendium was around the portability of the devices (access anywhere anytime) and how they could make better use of quiet times in the placement setting to consolidate learning, i.e. the immediacy of access (sometimes in remote locations from the University) as well as the quickness of access (Scordo, 2003; Altmann and Brady, 2005; Brubaker *et al.*, 2009; Coulby *et al.*, 2011). As such, the resources proved to be very useful to the students as many of whom didn’t want to return the PDA and Companion compendium, and others expressed that they would consider purchasing the Dr Companion once qualified. One student clearly articulated the benefits of the resource:
“I found that the Dr Companion and the PDA had many practical applications. Having such easy access to so much information helped facilitate my learning and ultimately improve my performance in clinical setting.” (NCL Medical)

In November 2011, the Department of Health published their Technology Enhanced Framework (TEL) document (Department of Health, 2011), the focus of which is simulation, e-learning and new technologies (e.g. smartphones). The TEL framework sets out a number of recommendations around the use of technology to improve patient outcomes, safety and experience; an example of this is " ...smart-phones, provide unprecedented opportunities for health and social care students, trainees and staff to acquire, develop and maintain the essential knowledge, skills, values and behaviours needed for safe and effective patient care." (p6) and echoes with the findings from our pilots, that mobile technology facilitates learning and ultimately has an impact in the clinical setting.

The NUS, in their October 2010 report, to HEFCE (Higher Education Funding Council for England, 2010), stated that, in their survey, "opinion was divided over whether mobile phones or PDAs should be used to assist learning with 37.3% agreeing, 35.4% disagreeing and 27.4% remaining neutral". This reflects our findings in that some students valued the resources for assisting learning, whilst others failed to engage with the resources. This raises the question around offering such resources: are they are replacement for traditional resources (e.g. books) or only a supplement?

It seems clear that, for some students at least, access to mobile resources provides valuable additional learning opportunities. Since the pilots in this report commenced, there has been an explosion in the use of mobile technology which has implications for the design of resources and devices. Coupled with increased familiarity with mobile technologies through personal use, barriers to the use of mobile devices to support learning in both academic and clinical environments may be reduced. Further research is required to determine whether these recent changes have transformed the landscape of mobile learning for healthcare students.

9. References

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Appendix A – Durham University
Dr Companion Survey 1 2007/08

1. What is your anonymous ID?
2. How often do you use your PDA? (Never, Monthly, Weekly, Daily)
3. If you use your PDA, which function(s) do you use most? (Games, Calculator, Excel, Notes, Outlook, Pocket MSN, PowerPoint Mobile, Tasks, Word Mobile, Other)
4. Have you used ActivSync to synchronise your PDA with a computer? (Yes, No)
5. Have you used PowerPoint Mobile to view lecture slides? (Yes, No)
6. What do you find most useful about the PDA?
7. What do you find least useful about the PDA?
8. How often do you use the Dr. Companion software? (Never, Monthly, Weekly, Daily)
9. If you use Dr. Companion, which function(s) do you use most? (British National Formulary, British National Formulary for Children, Classification of Surgical Operations and Procedures (OPCS-4), Clinical Evidence, Chemlab References (NHS Reference Ranges used in Pathology), Cochrane Abstracts, Diagnostic Criteria from DSMIV-TR, EBM Guidelines, Electronic Medicines Compendium, International Classification of Diseases (10), Instant Pictorial Anatomy, NICE Guidance Compilation, Oxford Concise Medical Dictionary, Oxford Handbook of Clinical Medicine, Oxford Handbook of Clinical Specialities, Oxford Handbook of Clinical & Laboratory Investigations, Patient Organizations UK)
10. What do you find most useful about Dr. Companion?
11. What do you find least useful about Dr. Companion?
12. Have you downloaded any other programmes onto the PDA (e.g. Adobe Reader for Pocket PC)? (Yes, No)
13. If yes, which programmes have you downloaded?
14. Have you used headphones with the PDA? (Yes, No)
15. Is there any other use you have found for the PDA? (Yes, No)
16. If yes, can you specify?
17. Have you attended any of Dr. Curtis's PDA tutorials? (Yes, No)
18. Have you contributed to the Dr. Companion Blog on DUO? (Yes, No)
19. Have you contributed to the Dr. Companion Wiki on DUO? (Yes, No)

Appendix B – Durham University
Dr Companion Survey 2 2007/08

1. What is your anonymous ID?
2. How often did you use your PDA? (Never, Monthly, Weekly, Daily)
3. The PDA improved/supported my learning (Strongly agree, Agree, Neither Agree nor Disagree, Disagree, Strongly Disagree, Not Applicable)
4. If you used your PDA, which function(s) did you use most? (Games, Calculator, Excel, Notes, Outlook, Pocket MSN, PowerPoint Mobile, Tasks, Word Mobile, Other)
5. Have you used ActivSync to synchronise your PDA with a computer? (Yes, No)
6. Have you used PowerPoint Mobile to view lecture slides? (Yes, No)
7. Did you access the internet using your PDA? (Yes, No)
8. Would access to the University's wireless network on the PDA have increased its usefulness in supporting your learning? (Yes, No)
9. What did you find most useful about the PDA?
10. What did you find least useful about the PDA?
11. How would you change the PDA to better support your learning?
12. Did you download any other programmes onto the PDA (e.g. Adobe Reader for Pocket PC)? (Yes, No)
13. If yes, which programmes have you downloaded?
14. Did you use headphones with the PDA? (Yes, No)
15. Is there any other use you have found for the PDA? (Yes, No)
16. If yes, can you specify?
17. How often do you use the Dr. Companion software? (Never, Monthly, Weekly, Daily)
18. Dr Companion improved/supported my learning (Strongly agree, Agree, Neither Agree nor Disagree, Disagree, Strongly Disagree, Not Applicable)
19. If you used Dr. Companion, which function(s) did you use most? (British National Formulary, British National Formulary for Children, Classification of Surgical Operations and Procedures (OPCS-4), Clinical Evidence, Chemlab References (NHS Reference Ranges used in Pathology), Cochrane Abstracts, Diagnostic Criteria from DSMIV-TR, EBM Guidelines, Electronic Medicines Compendium, International Classification of Diseases (10), Instant Pictorial Anatomy, NICE Guidance Compilation, Oxford Concise Medical Dictionary, Oxford Handbook of Clinical Medicine, Oxford Handbook of Clinical Specialities, Oxford Handbook of Clinical & Laboratory Investigations, Patient Organizations UK)
20. What did you find most useful about Dr. Companion?
21. What did you find least useful about Dr. Companion?
22. How would you change Dr Companion to better support your learning?
23. Did you use the DocTool search facility on Dr Companion? (Yes, No)
24. Did you use the Dr Companion software in: (The PDA, A computer, Both PDA and Computer, Neither)
25. Describe a time when the PDA/Dr Companion helped your learning (feel free to describe more than one occasion if applicable).
26. Do you think that the PDA and Dr Companion are useful learning tools for Phase 1 Medical students? (Yes, No)
27. Please justify your answer.

28. Do you think that PDAs and Dr Companion would be a useful learning tool for a Phase 2 Medical student? (Yes, No)
29. Please justify your answer.
30. What features or functions would you add to the PDA or Dr Companion to support your learning?
31. Have you contributed to the Dr. Companion Blog on DUO? (Yes, No)
32. Have you contributed to the Dr. Companion Wiki on DUO? (Yes, No)
33. Do you have any other feedback regarding the PDA or Dr Companion?

Appendix C – Durham University
Dr Companion Final Survey 2 2008/09

1. What is your anonymous ID?

2. How often did you use your PDA?

Never

Monthly

Weekly

Daily

3. The PDA improved/supported my learning

1. Strongly Agree
2. Agree
3. Neither Agree nor Disagree
4. Disagree
5. Strongly Disagree
6. Not Applicable

4. If you used your PDA, which function(s) did you use most?

Games

Calculator

Excel

Notes

Outlook

Pocket MSN

PowerPoint Mobile

Tasks

Word Mobile

Other

5. Did you use ActiveSync to synchronise your PDA with a computer?

Yes/No

6. Did you use PowerPoint Mobile to view lecture slides?

Yes/No

7. Did you access the internet using your PDA?

Yes/No

8. Would access to the University's wireless network on the PDA have increased its usefulness in supporting your learning?

Yes/No

9. What did you find most useful about the PDA?

10. What did you find least useful about the PDA?

11. How would you change the PDA to better support your learning?

12. Did you download any other programmes onto the PDA (e.g. Adobe Acrobat Reader for Pocket PC)?

Yes/No

13. If yes, which programmes have you downloaded?

14. Did you use headphones with the PDA?

Yes/No

15. Is there any other use you have found for the PDA?

Yes/No

16. If yes, can you specify?

17. How often did you use the Dr Companion software?

Never

Monthly

Weekly

Daily

18. Dr Companion improved/supported my learning

1. Strongly Agree
2. Agree
3. Neither Agree nor Disagree
4. Disagree
5. Strongly Disagree
6. Not Applicable

19. If you used Dr Companion, which function(s) did you use most?

British National Formulary

British National Formulary for Children

Classification of Surgical Operations and Procedures (OPCS-4)

Clinical Evidence

Chemlab References(NHS reference ranges used in Pathology)

Cochrane abstracts

Diagnostic Criteria from DSMIV-TR

EBM guidelines

Electronic Medicines Compendium

International Classification of Diseases (10)

Instant Pictorial Anatomy

NICE Guidance Compilation

Oxford Concise Medical Dictionary

Oxford Handbook of Clinical Medicine

Oxford Handbook of Clinical Specialities

Oxford Handbook of Clinical and Laboratory Investigations

Patient Organizations UK

20. What did you find most useful about Dr Companion?

21. What did you find least useful about Dr Companion?

22. How would you change Dr Companion to better support your learning?

23. Did you use the DocTool search facility on Dr Companion? Yes/No

24. Did you use the Dr Companion software in

The PDA

A computer

Both PDA and computer

Neither

25. Describe a time when the PDA/Dr Companion helped your learning (feel free to describe more than one occasion if applicable).

26. Do you think that the PDA and Dr Companion are useful learning tools for Phase 1 Medical students?

Yes/No

27. Please justify your answer.

28. Do you think that PDAs and Dr Companion would be a useful learning tool for a Phase 2 Medical student?

Yes/No

29. Please justify your answer.

30. What features or functions would you add to the PDA or Dr Companion to support your learning?

31. Have you contributed to the Dr Companion Blog on DUO?

Yes/No

32. Have you contributed to the Dr Companion Wiki on DUO?
Yes/No

33. Do you have any other feedback regarding the PDA or Dr Companion?

Appendix D – Newcastle University and James Cook Dr Companion Questionnaire

Dear Student,
Thank you for participating in this short questionnaire. This should take between 10-15 minutes to complete and will be essential in determining whether this software suite will be used in future training. Please answer **ALL** of the questions with a response and complete the survey in one sitting. If you wish, you may read all the questions before starting but remember that the questions are not saved until you have clicked the submit button.
Please enter your 9-digit student number as it appears on your student ID card:

1. Rotation Locations

These questions relate to the 12 week period from September to December 2008 where you covered the four units: *Child Health*, *Mental Health*, *Primary Care* and *Women's Health*.
1.1. Please indicate your main base unit, from this list:
CHOOSE ONE
1.2. If you were in a hospital other than your main base unit than please specify:

2. Technical Experience

2.1. Please indicate (with one or more ticks) whether you have used Doctor Reference Suite on the following technical platforms:
PDA Laptop PC Other -please specify:
2.2. Have you used a PDA previously?
Yes No

3. Use of Resources

3.1 What resources on Doctor Companion have you used on more than one occassion? For those you have used, please grade them from 1 (low quality or not useful at all) to 10 (high quality or very useful/indispensable).

A. DocTool Search
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

B. BNF 54
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

C. BNF for Children
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

D. Chemlab References
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

E. Classification of Surgical Operations and Procedures 4:e

Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
F. Clinical Evidence
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
G. Cochrane Abstracts
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
H. Diagnostic Criteria from DSM IV-TR
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
I. EBM Guidelines
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
J. electronic Medicines Compendium
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
K. Instant Pictorial Anatomy
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
L. International Classification of Diseases 10
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
M. Nice Guidance Compilation 10:e
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
N. Oxford Concise Medical Dictionary 6:e
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
O. Oxford Handbook of Clinical & Laboratory Investigations 2:e
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
P. Oxford Handbook of Clinical Medicine 7:e
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
Q. Oxford Handbook of Clinical Specialities 7:e
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
R. Patient Organizations UK
Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
3.2. Please briefly give up to three examples of how you have used any of these resources, please specify the name of the resource(s) in your response:
4. Use within the Rotation Units
4.1. Did you use any of the software suite during the **Primary Care** unit?
Yes No N/A, did not complete the Primary Care unit.

4.2. If applicable, please comment on how any (please specify) of the software suite supported *clinical learning*, *decision making* and/or *achieving learning outcomes* for the **Primary Care** unit?
4.3. Did you use any of the software suite during the **Mental Health** unit?
Yes No N/A, did not complete the Mental Health unit.
4.4. If applicable, please comment on how any (please specify) of the software suite supported *clinical learning*, *decision making* and/or *achieving learning outcomes* for the **Mental Health** unit?
4.5. Did you use any of the software suite during the **Women's Health** unit?
Yes No N/A, did not complete the Women's Health unit.
4.6. If applicable, please comment on how any (please specify) of the software suite supported *clinical learning*, *decision making* and/or *achieving learning outcomes* for the **Women's Health** unit?
4.7. Did you use any of the software suite during the **Child Health** unit?
Yes No N/A, did not complete the Child Health unit.
4.8. If applicable, please comment on how any (please specify) of the software suite supported *clinical learning*, *decision making* and/or *achieving learning outcomes* for the **Child Health** unit?

5. Strengths & Weaknesses

You have had prior experience at locating similar reference material without the use of the Doctor Companion software.
5.1. Please list the positive aspects for you in using Doctor Companion?
5.2. What problems or barriers have you encountered in using Doctor Companion?

6. Suggestions & Comments

6.1. Please list the ways we could improve Doctor Companion or the way it works to better support your learning practice:
6.2. If you have any other comments about Doctor Companion, then please list them here:
6.3 Would you be willing to be contacted for a brief follow-up on issues related to this pilot? Yes No
You have now reached the end of the questionnaire - please click the Submit button below.

Appendix E – Teesside University
Nurse Companion Questionnaire

Dear Student,
Thank you for participating in this short questionnaire. This should take between 10-15 minutes to complete and will be essential in determining whether this software suite will be used in future training. Please answer **ALL** of the questions with a response and complete the survey in one sitting. If you wish, you may read all the questions before starting but remember that the questions are not saved until you have clicked the submit button.
Please enter your full student id number:
All of the following questions relate to the time period during your nursing course when you have had the opportunity to use the **Nurse Companion** collection.

1. Personal Context

1.1. Please indicate your current age, from these three age-range options:
25 and below 26 to 39 40 and above

2. Technical Experience

2.1. Please indicate (with one or more ticks) whether you have used the **Nurse Companion** Reference Suite on the following technical platforms:
PDA Laptop PC Other - If 'other', please specify:
2.2. Have you used a PDA previously?
Yes No

3. Use of Resources

3.1 What resources on Nurse Companion have you used on **more than one occassion***? For those you have used, please grade them from 1 (low quality or not useful at all) to 10 (high quality or very useful/indispensable).

A. DocTool Search
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

B. BNF 56
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

C. Chemlab References
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

D. Clinical Evidence
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

E. International Classification of Diseases 10
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

F. Netter Atlas of Human Anatomy 3:e
*Did you use? Yes No

Your grade? 1 2 3 4 5 6 7 8 9 10
G. Oxford Handbook of Cancer Nursing
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
H. Oxford Handbook of Cardiac Nursing
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
I. Oxford Handbook of Chrildren's and Young People's Nursing
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
J. Oxford Handbook of Mental Health Nursing
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
K. Patient Organizations UK
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
L. Steadman's Medical Dictionary
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10
3.2. Please briefly give up to three examples of how you have used any of these resources, please specify the name of the resource(s) in your response:
4. Use within the Course
4.1. When did you **predominately** use the Nurse Companion reference suite?
Before dealing with a patient.
During an encounter with a patient.
After dealing with a patient.
Outside of the patient encounter/session.
4.2. Did you use the Nurse Companion reference suite during periods of **study**?
Yes No
If 'yes', please give an example of what Nurse Companion was used for during study,
If 'No', please give an example of what Nurse Companion was used for during clinical work*:
**clinical work as defined as periods of contact with patients and clinical/teaching staff.*
4.3. Please give another example of how you found the use of the Nurse Companion Reference Suite in supporting your **clinical work***?
5. Strengths & Weaknesses
You have had prior experience at locating similar reference material without the use of the Nurse Companion software.
5.1. Please list the positive aspects for you in using Nurse Companion?
5.2. What problems or barriers have you encountered in using Nurse Companion?
6. Suggestions & Comments
6.1. Please list the ways we could improve Nurse Companion or the way it

works to better support your learning practice:
6.2. If you have any other comments about Nurse Companion, then please list them here:
You have now reached the end of the questionnaire - please click the Submit button below.

Appendix F – The University of Sunderland Pharmacy Companion Questionnaire

Dear <Student name here>,
Thank you for participating in this short questionnaire. This should only take 10 minutes to complete and will be essential in determining whether this software suite will be used in future training. Please answer **ALL** of the questions with a response and complete the survey in one sitting. If you wish, you may read all the questions before starting but remember that the questions are not saved until you have clicked the submit button.
Please enter your full student id number:
All of the following questions relate to the time period during your nursing course when you have had the opportunity to use the **Pharmacy Companion** collection.

1. Personal Context

1.1. Please indicate your placement location, from this list:
CHOOSE ONE
1.2. Please indicate your current age, from these three age-range options:
25 and below 26 to 39 40 and above

2. Technical Experience

2.1. Please indicate (with one or more ticks) whether you have used the **Pharmacy Companion** Reference Suite on the following technical platforms:
PDA Laptop PC Other - If 'other', please specify:
2.2. Have you used a PDA previously?
Yes No

3. Use of Resources

3.1 What resources on Pharmacy Companion have you used on **more than one occassion***? For those you have used, please grade them from 1 (low quality or not useful at all) to 10 (high quality or very useful/indispensable).

A. DocTool Search
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

B. BNF 57
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

C. BNF for Children
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

D. Chemlab References
*Did you use? Yes No
Your grade? 1 2 3 4 5 6 7 8 9 10

E. electronic Medicines Compendium
*Did you use? Yes No

Your grade? 1 2 3 4 5 6 7 8 9 10

F. Oxford Handbook of Clinical Pharmacy

*Did you use? Yes No

Your grade? 1 2 3 4 5 6 7 8 9 10

G. Stockley's Pocket Companion

*Did you use? Yes No

Your grade? 1 2 3 4 5 6 7 8 9 10

3.2. Please briefly give up to three examples of how you have used any of these resources, please specify the name of the resource(s) in your response:

4. Use within the Placement

4.1. Did you have contact with patients?

Yes No

If 'Yes', when did you **predominately** use the Pharmacy Companion reference suite?

Before dealing with a patient.

During an encounter with a patient.

After dealing with a patient.

Outside of the patient encounter/session.

4.2. Did you use the Pharmacy Companion reference suite to aid you in any part of the **case study process**?

Yes No

4.3 Please list the titles of each of your **case studies** (one per line):

4.4. Please give an example of how Pharmacy Companion may have helped with one of these **case studies**?

If not applicable to the case studies, comment on how it helped with an aspect of the placement.

4.5. Please give another example of how Pharmacy Companion helped with an **aspect of the placement**?

5. Strengths & Weaknesses

You have had prior experience at locating similar reference material without the use of the Pharmacy Companion software.

5.1. Please list the positive aspects for you in using Pharmacy Companion?

5.2. What problems or barriers have you encountered in using Pharmacy Companion?

6. Suggestions & Comments

6.1. Please list the ways we could improve Pharmacy Companion or the way it works to better support your learning practice:

6.2. If you have any other comments about Pharmacy Companion, then please list them here:

You have now reached the end of the questionnaire - please click the Submit button below.

Appendix G
Dr Companion Resources (Durham, Newcastle and James Cook)

DocTool Search

BNF 54

BNF for Children

Chemlab References

Classification of Surgical Operations and Procedures 4:e

Clinical Evidence

Cochrane Abstracts

Diagnostic Criteria from DSM IV-TR

EBM Guidelines

electronic Medicines Compendium

Instant Pictorial Anatomy

International Classification of Diseases 10

Nice Guidance Compilation 10:e

Oxford Concise Medical Dictionary 6:e

Oxford Handbook of Clinical & Laboratory Investigations 2:e

Oxford Handbook of Clinical Medicine 7:e

Oxford Handbook of Clinical Specialities 7:e

Patient Organizations UK

Appendix H
Nurse Companion Resources – Teesside University

Nurse Companion Resources


DocTool Search


BNF 56

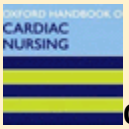

Chemlab References


Clinical Evidence


International Classification of Diseases 10


Netter Atlas of Human Anatomy

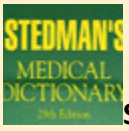

Oxford Handbook of Cancer Nursing


Oxford Handbook of Cardiac Nursing


Oxford Handbook of Children's and Young People's Nursing


Oxford Handbook of Mental Health Nursing


Patient Organizations UK


Steadman's Medical Dictionary

Appendix I
Pharmacy Companion Resources – The University of Sunderland


DocTool Search

BNF 57

BNF for Children

Chemlab References

electronic Medicines Compendium

Oxford Handbook of Clinical Pharmacy

Stockley's Pocket Companion

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