Futurelab: Learning with handheld technologies

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HANDHELDS

learning with handheld technologies

a handbook from Futurelab

00 summary recommendations

Recommendations on planning and implementation

A shared plan that integrates the use of handhelds with existing ICT and learning strategies is a common feature of successful projects.

- Having an authentic purpose for use of the devices is central to the success of implementing handheld technologies to enhance teaching and learning.
- Educators should be clear about the exact learning goals they are hoping to achieve when using handheld technologies – these may be as much about the culture of learning as about specific content or skills.
- Although some successes have resulted from models of use where not every learner has a device, or where the devices are not 'owned' by learners, teachers find it harder to manage small numbers of devices in a whole class context.

Recommendations on outreach

Engaging families in learning, and extending the links between school and home learning has been a feature of many successful projects.

- Projects that have tested the use of handhelds to build links between home and school, and to increase family involvement have had most success where the level of home access to technology is low. In cases where home access is already high, a very specific role for the handhelds may be more effective, eg to carry information between home and school.

Recommendations for professional development

The training and support of teachers is critical to the success of any of the projects examined here.

- To develop a collaborative, self-supporting community of practice, adequate and appropriate training is a fundamental part of any successful project.
- A whole school approach, with support provided both for the project activity and for those implementing it, will contribute to handheld technologies being embedded in the curriculum.

Recommendations on technology provision and support

Teaching with handheld technologies will require planning in conjunction with school technical support staff in order to identify any potential network or technical difficulties.

- The provision of internet connectivity, preferably via a wireless configuration, rather than access through a wired local area network (LAN), is essential if ubiquitous computing is to be facilitated. Devices with no connectivity have not proved popular or sufficiently useful.
- Longer term storage of work needs careful planning as in general learners will produce more digital work, both in volume and variety.
- Devices need to be robust and broken devices must be repaired or replaced quickly. Some spare devices will be needed to cover periods when a device is out of action.

Recommendations on teaching and learning

To maximise the benefits of personal ownership, pedagogical approaches and teaching styles must accommodate a more autonomous learner role.

- The curriculum itself needs to accommodate this new attitude to learner responsibility for the approach to learning.
- The most successful projects combine the use of the device to access curriculum content and to produce student work in a variety of media, and lessons are planned to take advantage of both use and production of content.
- The time taken to manage the devices, in projects with personal ownership, takes up very little class time once the devices are established, leaving more time for the wider educational objectives of the lesson.
- Good integration with existing technologies in the school, eg interactive whiteboards, data projectors, software and digital content, aids the smooth adoption of the devices into routine teaching and learning.

Learning with handheld technologies

A handbook from Futurelab

Authors

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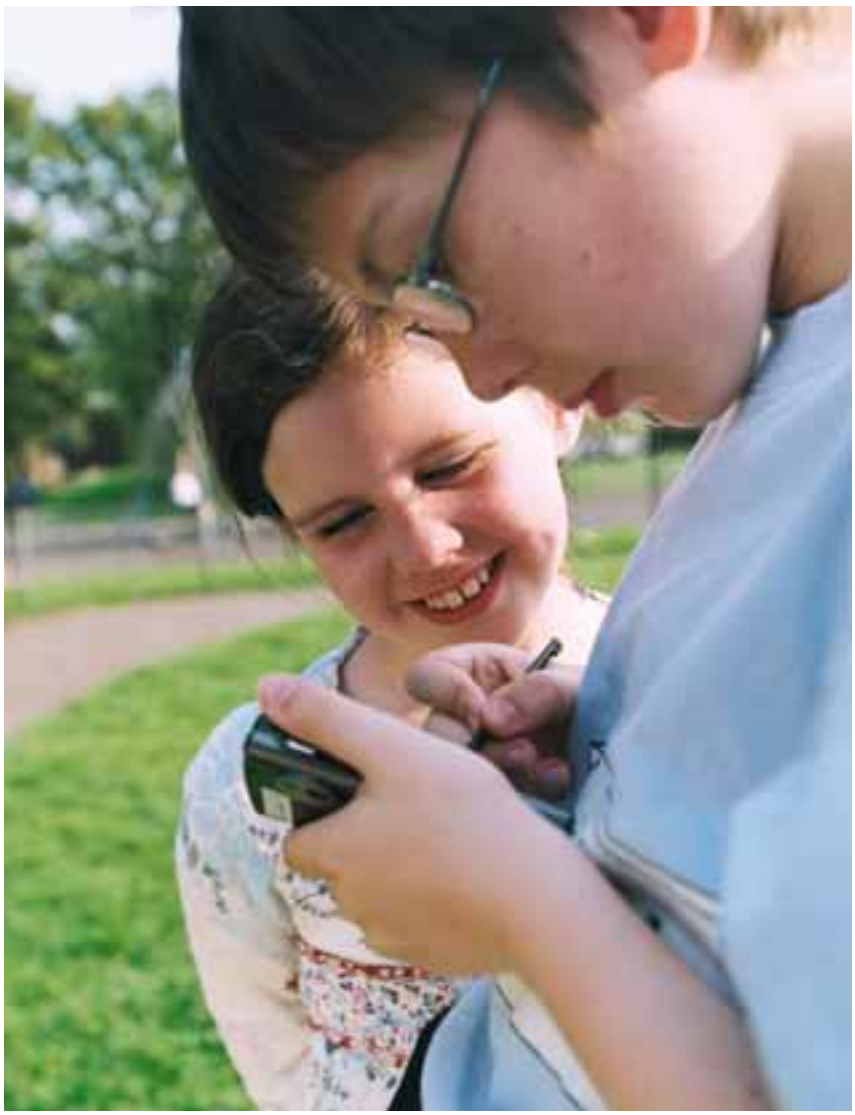

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FOREWORD

Futurelab's handbooks are part of our 'practical guidance' series of publications. Their purpose is to collate emerging practice in the design and use of digital technologies for learning and to identify key themes which can act as useful recommendations for practitioners, developers and policy makers interested in each area. The handbooks are based on a wide range of Futurelab activities and on the activities of our partner organisations, including:

- cutting edge and experimental development of digital technologies for learning
- empirical and action research into new approaches to teaching and learning with digital technologies
- formative evaluations of existing exemplary or innovative practice
- events, seminars and workshops with leading practitioners, policy makers, children and representatives from creative and technology sectors.

This handbook on learning with handheld technologies arises from a two year study by the Graduate School of Education, University of Bristol with which Futurelab has been closely involved. This study comprised observations and interviews with some of the leading practitioners of handheld learning in the UK, and desk-based research to identify other developing projects in this area. In the course of the project, a number of key recommendations and observations emerged which have been distilled by the researchers on the project in this publication.

While these handbooks are not intended as definitive statements of 'best practice' in an area – indeed, their aim is more to stimulate reflection on the many ways in which new practice might emerge – we hope you will find them a useful guide and introduction to areas of interest and emerging practice. If you have any comments to make, or suggestions of other projects and research we should be aware of, please do let us know.

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01 introduction
why the interest in using handheld technologies for learning?

In this handbook we focus on 'handheld' technologies – in other words, portable, mobile technologies which can be held in the hand and which can therefore be used 'ubiquitously', that is in any location or context. These devices might include high specification mobile phones, personal digital assistants (PDAs) or ultra-mobile PCs, games consoles and MP3 players. In this collection we have concentrated on devices that offer access to a set of applications and content that mirror those on a laptop or desktop PC. We have excluded devices that are principally for storing data, eg MP3 players, or those designed primarily as phones even where they do have web access. This is not because we do not believe those devices have no place in education, indeed there are some very worthwhile experiments in progress. However, this handbook reflects the current high level of interest in and experimentation with what we are calling 'handhelds', although the users often refer to them as 'PDAs'.

In this report we are looking at devices that have a general purpose specification and can be seen as offering access to a full range of tools and content, applicable across the curriculum, and that can be seen as offering personal access to the full range of ICT applications. Moreover these devices can be carried around in a pocket, and have a battery life that will last a working day.

A growing number of educators are taking an interest in such handheld technologies for learning, for a number of reasons. First, there is the question of how to encourage personalisation of learning and enhance learner responsibility[1]; second, there are the organisational and logistical difficulties of enabling teachers and learners to use digital technologies to enhance all aspects of learning (the drive to 'embed' digital technologies instead of relying on the all-too-familiar computer suite)[2]; and third, there is the challenge of creating coherent links between children's experiences of learning across different sites and across home, school and community[3].

Handheld technologies, in principle, could enable schools to address these three concerns; they can act as tools that are available to the individual learner to be managed and personalised by them and they are portable, supporting access to information and resources in all lessons and all educational and domestic environments regardless of the availability of desktop computers.

Finally there are, of course, the issues of cost and sustainability. Handheld devices have been cheaper to purchase than either laptop computers or tablet PCs and this alone has acted as an encouragement for some schools and local authorities to start exploring how they might be used in the classroom.

The aims of this handbook

At the present time a number of local authorities, schools, colleges and universities in the UK are experimenting with the use of handheld technologies for a range of different purposes – from teaching and learning, to administration, to widening access to digital resources (see, for example, Perry 2003). At the same time, educational researchers are beginning to generate a body of research evidence to indicate the potential for these technologies to support new approaches to teaching and learning, and developers, practitioners and policy makers are beginning to generate communities in which to share experience and expertise in the field (see Useful links and resources).

[1] See DfES Five Year Strategy for Children and Learners (2005) **www.dfes.gov.uk/publications/5yearstrategy/**; DfES Higher Standards, Better Schools For All – More Choice For Parents and Pupils (2005) **www.dfes.gov.uk/publications/schoolswhitepaper/**; and the 2006 Gilbert Review of Teaching and Learning 2020.

[2] See DfES E-strategy Harnessing Technology: Transforming Learning and Children's Services (2005). **www.dfes.gov.uk/publications/e-strategy/**

[3] See the Building Schools for the Future programme (**www.bsf.gov.uk**) and the 2005 White Paper commitments to 'extended education' and to enhance connections between learning in homes and schools.

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This handbook should be read in the context of these activities; its aim is not to replicate the work of these individuals or organisations, but instead, to provide a practical first point of call for those developing an interest in this application of technology to support learning.

The handbook has two aims; to draw out the lessons learnt from experimentation in the area thus far, and to offer an overview of the range of such early trials. The handbook therefore offers a guide and resource for those considering exploring handheld technologies for teaching and learning purposes. Four case reports provide an insight into how different schools, LAs and, in some cases, individuals have attempted to tap the potential of handheld technology for learning. A wider survey of projects in the UK and beyond gives the reader a sense of the range of ongoing handheld learning projects along with contact information to allow those interested in pursuing these ideas further to contact others working with the same challenges.

The handbook therefore comprises:

1. **Key messages –** lessons learnt, guidelines and suggestions for further development based on a series of in-depth studies and a wider survey, aimed at those interested in exploring handheld learning activities.

2. **Four case reports of handheld learning projects –** detailed discussion of the goals of each project, the ways in which they were implemented and an evaluation of the success of the project against its original goals in the views of the participants.

3. **Directory of handheld learning projects –** summary information and contact details for over 35 handheld projects in the UK and beyond.

4. **Sources of further information.**

02 key messages

Handheld technologies have yet to be embedded within the wider school system but results from projects so far indicate that student concentration and confidence blossom, and it seems the use of handheld devices can result in improved ICT skills, increased home/school links and better social interactions. One project reports improvements in Key Stage Test scores that they attribute to the use of handheld devices.

The use of handheld technologies in the classroom may present difficulties for those teachers who do not fully understand their potential in a teaching and learning context. This is exacerbated where personal ownership of the devices by pupils precipitates the need for a different teaching style. It is therefore important that any project design should include support for teachers, together with help and ideas on how to use the devices as a teaching and learning tool in order to meet the objectives of the implementation. This would include consideration of when it is, and is not, appropriate to use the technology and might usefully include consideration of ways in which technical difficulties might hinder classroom practice and how this can be avoided. There is also a need to consider where there may be a correspondence with or divergence from the existing curriculum and pedagogy, because tensions develop where handheld technologies are used in a very teacher-centric learning culture.

It is also important to acknowledge that the use of handheld technologies for learning remains a new area for education. While our review of existing research and projects provides strong evidence for the recommendations we make below, a number of key questions still need to be addressed if we are to fully understand the role these technologies may play in education in the future. Specifically, we would argue that the following questions merit further exploration:

- Which models of ownership support learning in which contexts?
- Which students benefit from learning with handheld technologies and in which contexts?
- To what extent are the lessons learnt from small-scale projects transferable when handheld technologies are extended across larger numbers of students, teachers and schools?
- Are emerging short-term benefits sustainable in the long term?
- To what extent can handheld technologies act as assessment tools?
- Are there specific ways in which handheld technologies support learning, for example as tools for collecting and editing learners' work in multiple media, or as a delivery mechanism for curriculum content?

Recommendations

Recommendations on planning and implementation

There are a number of schools already using handheld technologies; for those considering taking this step, we would recommend the following:

- Having an authentic purpose for use of the devices is central to the success of implementing handheld technologies to enhance teaching and learning, and educators may benefit from having examples of use to follow.
- Educators should reflect upon where there may be matches and mismatches with the existing curriculum and pedagogy, and devise strategies to accommodate the mismatches.

02 key messages

- Educators should be clear about the exact learning goals they are hoping to achieve when using handheld technologies – these may be as much about the culture of learning as about specific content or skills.
- Although some successes have resulted from models of use where not every learner has a device, or where the devices are not 'owned' by learners, teachers find it harder to manage small numbers of devices in a whole class context.
- Educators should not feel obliged to use handheld technologies in all lessons. It is more likely that there are particular activities which are appropriate for their use.
- Educators need to be aware that not all students will benefit from using handheld technologies at all times and some may prefer more conventional activities.

Recommendations on outreach

Engaging families in learning, and extending the links between school and home learning have motivated many projects. Early findings suggest:

- Projects that have tested the use of handhelds to build links between home and school, and to increase family involvement have had most success where the level of home access to technology is low. In cases where home access is already high, a very specific role for the handhelds may be more effective eg to carry information between home and school.
- Internet access has proved problematic in the out-of-school context where it depends on a physical connection, eg via a phone socket.
- Wireless connectivity beyond school has cost implications which need considering at the outset of a project.

Recommendations for professional development

The training and support of teachers is critical to the success of any of the projects examined here.
In particular:

- To develop a collaborative, self-supporting community of practice, adequate and appropriate training is a fundamental part of any successful project.
- A whole-school approach, with support provided both for the project itself and those implementing it, will contribute to handheld technologies being embedded in the curriculum.
- Attendance at seminars and conferences may prove helpful and offer support.
- Without support, teachers may feel overwhelmed by how to approach this new mode of teaching and learning.

Recommendations on technology provision and support

Teaching with handheld technologies will require planning in conjunction with school technical support staff in order to identify any potential network or technical difficulties.

- At the planning stage of implementing handheld technologies within schools involvement of all parties is critical; dialogue between various service providers should be mediated so that those without technical expertise can fully comprehend the implications of what is being planned, as well as convey their own concerns and aspirations.
- Handhelds offer a lower cost alternative to desktop or portable computers, but offer a somewhat different toolset. The way this integrates with and/or complements existing IT infrastructure needs careful thought. Projects that bought handhelds as a straight alternative to the PC did not achieve satisfactory outcomes.

02 key messages

- The provision of internet connectivity, preferably via a wireless configuration, rather than access through a wired local area network (LAN), is essential if ubiquitous computing is to be facilitated. Devices with no connectivity have not proved popular or sufficiently useful.
- The wireless network must offer sufficient coverage and capacity to support all devices accessing the network at one time.
- The device and software chosen should complement the existing technology infrastructure in the school.
- The device needs adequate memory capacity allowing the ability to store and beam both files and applications.
- Longer term storage of work needs careful planning as in general there will be more work in this form, both in volume and variety.
- Devices need to be robust and broken devices must be repaired or replaced quickly. Some spare devices will be needed to cover periods when a device is out of action.
- The provision of memory cards will ensure that where replacement occurs, student personalisation and work is not lost.
- Software provision must be adequate and fit for purpose. The greatest success in early projects has depended on partnership with providers of existing educational content, versioned for the handheld device.
- Educators should consider that putting passwords onto devices may lead to difficulties if the passwords are then forgotten.

Recommendations on teaching and learning

Emergent findings suggest a number of points that are relevant to teaching and learning with handheld devices:

- To maximise the benefits of personal ownership, pedagogical approaches and teaching styles must accommodate a more autonomous learner role, for example where pupils are encouraged to make suggestions and given permission to make choices about when and how they use their device to support their learning.
- The curriculum itself needs to accommodate this new attitude to learner responsibility for the approach to learning.
- The most successful projects combine the use of the device to access curriculum content and to produce student work in a variety of media, and lessons are planned to take advantage of both use and production of content.
- Learners will develop a facility with the devices quite quickly, often led by class champions. Strategies and time to recognise and share this expertise as it evolves pays dividends. For example, encouraging learners to share new knowledge and show others, who must then pass on this new skill, ensures a viral transfer of new knowledge.
- The time taken to manage the devices, in projects with personal ownership, takes up very little class time once the devices are established, leaving more time for the wider educational objectives of the lesson.
- Good integration with existing technologies in the school, eg interactive whiteboards, data projectors, software and digital content, aids the smooth adoption of the devices into routine teaching and learning.

Any project design should include support for teachers, together with help and ideas on how to use the devices as a teaching and learning tool in order to meet the objectives of the implementation.

03 case reports on four handheld learning projects

This section describes four different handheld learning projects that have taken place in the UK. They were selected primarily because they were sufficiently mature to offer some preliminary findings and inform others wishing to begin a handheld project. In addition, they each offer different approaches to the use of handheld technologies for teaching and learning. This range of approaches offers a corresponding range of insights into the start-up and implementation of different models of use.

For each case report, researchers visited the schools, interviewed staff and students and observed lessons. The evaluation of the success of each project is conducted not against an external evaluation framework, but against the goals established for the project in the views of the participants. Each of the case reports presents some background information, before discussing the main aims of the project and describing what happened; finally, some comments are made about the extent to which the projects achieved their own aims and objectives.

Dudley Handhelds Initiative

Device type:
mixed - PalmOne Zire 72; Tungsten C; T2

Connectivity:
mixed – wifi; wired connection via LAN

Device ownership:
mixed – personal ownership and distribution models

Number of students:
300 (approximately)

Introduction and context

Dudley Local Authority (LA) offers education services to more than 50,000 students attending its 112 primary and secondary schools. The LA is aiming for one-to-one access to ICT in education for pupils in its schools, encouraged by the belief that this will contribute to raising educational standards by extending learning opportunities to all pupils. The LA is keen to use ICT to offer opportunities for tailored educational provision to individuals, to raise standards of literacy and numeracy, to encourage collaborative learning, and to motivate learners. The LA believes that the technology needed to support these goals should be central to both teaching and learning, contextually relevant, accessible, portable and capable of providing ubiquitous computing. In particular, the LA wants to target disaffected learners and disadvantaged students and believes that the provision of handhelds, which can be taken home, will motivate students to become more independent learners. The LA also recognises that in order to achieve these objectives, there will be a requirement for a reconsideration of pedagogy within schools, with a particular focus given to cross-curricular uses of technology and the development of innovative models of teaching and learning.

Main aims of the project

Parts of Dudley have low levels of access to technology and low family involvement with learning. The overall objective of the Dudley Handhelds Initiative was to both raise student standards of literacy and numeracy and to address adult literacy and numeracy issues by engaging families with their own learning through the provision of personal, portable computing to students.

The initiative's aims were to identify the most appropriate handheld for learners; to cost the project and establish a fund to allow subsidised access to the handhelds for families; to develop customised resources and learning scenarios accessed via the Dudley Virtual Resource Centre; to install numeracy and literacy resources on all handhelds; and to use pupil expertise to mentor parents and carers.

What happened?

The initiative provided approximately 300 handhelds to students across Years 5–10, in eight schools (6 x primary schools; 1 x secondary special school; 1 x mainstream secondary school), for use at both school and home.

03 case reports on four handheld learning projects

Different schools received different numbers and types of device and some schools had a mixture of devices. This difference in provision was important because it meant that not all students in a class necessarily had a handheld; also, there were compatibility issues between different models and the functionality of the devices varied. Each of the participant schools took an individual approach both to distribution of the handhelds and ways in which they were used.

The special needs secondary school, with approximately 120 students on roll, distributed 22 handhelds to a variety of students, with differing rationales for each group. For example, handhelds were given to the 'top ability' Year 10 group in order to improve their access to the curriculum; to students in the learning support unit as an encouragement/reward for appropriate behaviour; to travelling children, who otherwise had no access to ICT; and, in one case, to a student with a variety of difficulties, in an attempt to improve his self-esteem after his family had removed his home computer. There was a deliberate attempt to use the handhelds across the curriculum and this was achieved in English, physical education (PE), ICT, mathematics, art and humanities. Additionally, BlueChat (direct text chat between two or more users, using a Bluetooth device) and BlueBoard (a shared work area) applications were used to encourage collaborative working and social interaction. The use of Graffiti, a handwriting program, proved helpful in encouraging students who were reluctant to do so, to write. The school felt that whilst the novelty factor of the handhelds impacted on the community at large, it particularly impacted on the travelling community, for whom it was their only access to technology. Furthermore, attendance rates for students from this community increased dramatically and even families with limited financial means stated a willingness to pay for devices, if necessary, thus indicating a positive engagement with this element of formal education.

The mainstream secondary school gave handhelds to those students who were in a 'top set' grouping for English, mathematics, science or language lessons. Therefore lessons for these groups were sometimes structured around use of the handheld. Some of these students were not in a top set for all of these subjects. They took the handhelds to all their lessons, but other than with the top set, it was up to them whether they used the device. Teachers did not structure lessons around the handheld unless all students in a set had one. However, handhelds were used successfully for a variety of activities. In science lessons, for example, students created animations and used Margi Presenter to Go to link their handheld to a data projector to show their work to the class, whilst mathematics teachers made use of the graph-drawing packages. In languages, the teacher distributed a piece of text, via Bluetooth, to the class; students corrected the text, recorded their speaking of it and then 'beamed' it back to the teacher. Having listened to the recording and looked at the corrected text, the teacher would beam back a final version, or send back a comment on that piece of work.

Primary school 1 distributed handhelds to Year 5 students and to some members of staff. Students had full ownership of the handhelds, which were used for note-taking, English, collaborative work in mathematics,

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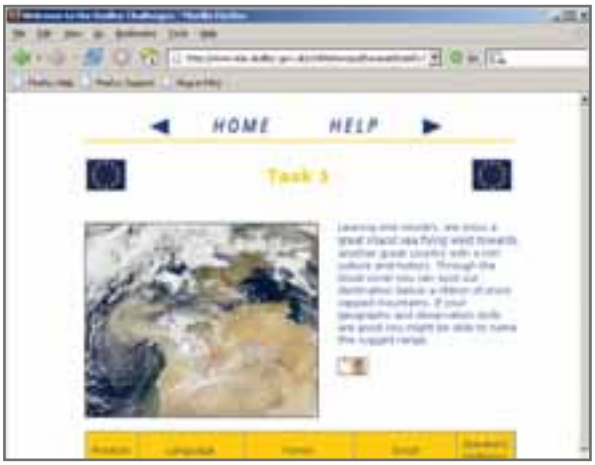

The Dudley Challenge

and the Dudley Challenge[4], which focused on problem solving. The head teacher believed that the school's existing high levels of technology, together with a variety of different technologies owned by the students, meant that the handhelds made little difference to widening access to ICT either in or out of school. Neither were the devices seen to improve school/home links and, after the initial excitement, the initiative rather lost momentum, with little discernible increase in positive engagement with formal education by either students or their families.

Primary school 2 distributed handhelds to Year 6 students, across the ability range, and to some members of staff. The handhelds were 'owned' in six-week blocks by three different groups at a time, thus extending access across the student group. This school had recently acquired a wireless network, and connecting the devices to a wireless local area network (LAN) had been the focus of its involvement with the initiative. Handhelds were used for note-taking, literacy activities, language work and exercises that required collaboration through the sharing of applications and files. Activities included some that required parental involvement and were done at home, which the head teacher felt had been successful.

The school believed that use of the handhelds impacted positively upon literacy development, attributing its success in literacy last year to the 'lower ability' students having used the handhelds. This school, which was the most affluent school in the initiative, didn't specifically feel that overall access to technology had increased since ownership of home computers was common and many of the parents already owned handhelds, but any increase in access to digital resources within school was seen in a positive light. The head teacher believed the devices enhanced school/home links and was keen to develop this positive engagement with formal education.

Primary school 3 distributed handhelds to Year 5 students, who had full ownership of the handhelds and used them across the curriculum, and to some members of staff. This school is in an area of extreme social deprivation and the majority of its students did not have access to technology other than that provided by the school. Consequently, increased access to technology was a prime feature of this school's involvement with the initiative. The school believed that use of the handhelds dramatically increased attendance figures at the start of the project and raised the self-esteem of its students. For some children, the use of the handhelds supported good attendance on an ongoing basis. Additionally, parents enjoyed using the handhelds, both with their children and individually. In order to further develop this positive engagement with formal education, the school would like access to e-books so that parents and children could read together; it is anticipated that this would impact not only on student literacy levels but also on parental literacy skills. Before the start of the handhelds project the school had been encouraging students to talk rather than 'shout' when communicating with each other but had experienced little success. However, having the handhelds led to students using the devices' voice record function to record ancillary staff shouting;

[4] The Dudley Challenge is a web-based, problem-solving challenge based on a 'virtual' air balloon journey.
www.edu.dudley.gov.uk/c2000/europa/cEuropa/

03 case reports on four handheld learning projects

this resulted in decreased volumes of both student and staff communication, but it also required discussion with students of the ethics of recording people without their knowledge or approval.

Primary school 4 distributed handhelds to all members of staff and then bought seven extra units for use with students in classes, or small groups. The handhelds were used with students across the primary age range. Although students were able to take the handhelds home on alternate weekends, they did not have full ownership of the devices. Given this school's low number of devices, the intention was to encourage selected Year 5 and Year 6 students to become champions, able to train other students, when more devices became available to the school. These students were selected because of an existing ability in ICT. The handhelds were used for The Dudley Challenge, which focused on problem-solving, as well as for research tasks, journal-keeping, storyboarding, using the camera, interviews and collaborative work.
This school serves a socially disadvantaged area where students do not generally possess high levels of technology at home. However, whilst the potential for increased access existed, the school's low number of devices, and the strategy it therefore employed in regard to ownership, limited that potential. The head teacher is keen to see ubiquitous computing within the school, but it has not yet been realised.

Primary school 5 distributed handhelds to six students and to various members of staff. Students had full ownership of the handhelds. Students were selected from a 'middle ability' group in order to build self-esteem. Handhelds were used in science, using an animation package, in mathematics, in English for storyboarding, and for mind mapping. Additionally, there was limited investigation of e-books, and games deemed to hold some educational value were used. This school only had six devices and also claimed that the vast majority of its students already had computers and laptops at home, with broadband internet connections, wifi connections and wireless networks, so there was no significant increase in access to technology as a result of the initiative.

Did the project achieve its goals?

The project aimed to provide handhelds to support learning by creating motivated, independent learners, removing the digital divide by linking handhelds to home or community located PCs and targeting disaffected learners. Additionally, it intended to develop customised resources and learning scenarios accessed via the Dudley Virtual Resource Centre[5], installing identified numeracy and literacy resources on all handhelds.

Two of the schools highlighted ways in which the handhelds benefited social aspects of learning, both formal and informal, which indicates progress toward achieving the LA's aim of the development of independent learners. One primary school emphasised the development of social skills and self-organisation, whilst the special needs secondary school highlighted social interaction.

"How hard do you try to get special needs to improve their social skills? And all of a sudden there comes this box that does this for you!" (acting deputy head, secondary special school)

Views on whether implementation of the initiative had increased children's access to digital resources, either in or out of school, were mixed. There are several variables to be considered in this regard, such as the number of devices allocated to schools, notions of 'ownership', and the socio-economic constitution of the area served by the schools. However, it is important to note that increased access to digital resources within the schools, whatever their socio-economic context, was deemed to be of considerable importance, especially where these resources facilitated ubiquitous computing in school.

[5] The Dudley Virtual Resource Centre provides a variety of electronic resources for educational use: **www.edu.dudley.gov.uk.**

03 case reports on four handheld learning projects

There was some variability but the majority of staff felt that use of the handhelds had extended community access to ICT, helping to forge stronger links with parents. Indeed, the impact of the devices on parents was generally perceived positively. There was also some evidence of positive impact on engagement with learning in the

One primary school teacher felt that the use of handhelds needed to be embedded within the curriculum but her lack of confidence, and hesitation as to how to use the devices in teaching and learning, highlighted a need for training. She felt that these issues had limited her involvement with the project and, also, may have impacted negatively on the

community. In several cases parents helped to locate and share resources for the handhelds and parental feedback was positive. It is believed that some students have 'taught' parents how to use the devices and, overall, it was felt that use of the handhelds had increased access to ICT provision outside of school.

Although there were some expressions of desire and even intent to use the devices to innovate in the classroom there was little evidence of this actually happening. A general lack of confidence in teaching with the handhelds was apparent; this ranged from insecurity in technical know-how, to doubts as to how the devices could be used to advantage within teaching and learning. This was further complicated by situations where not all students in a class owned or had access to handhelds. Additionally, technical issues such as synchronising the device with a PC or laptop, navigation, file storage, short battery life and the devices breaking down were problematic.

project generally. Whilst both teachers and head teachers highlighted training sessions as important, they also felt too few were offered.

The software provided on the devices was seen as inadequate by most teachers, but the reasons for this varied. Some clearly felt frustration at the inability to move practice on beyond that possible with current resources: "It's not just got to be a replacement for a book or something like that. It's got to take it further." The freely available e-books were found to be inappropriate; one school wanted to be able to access reading schemes via the handhelds and to have the ability to create their own e-books. Overall, it was felt that the handhelds should provide comparable provision to that which can be found on a desktop PC. Few expressed any desire to use the software tools available, such as the word processor, animation software etc but, rather, wanted curriculum-specific software. However, Margi links, which allow a handheld to be connected to a data projector, were

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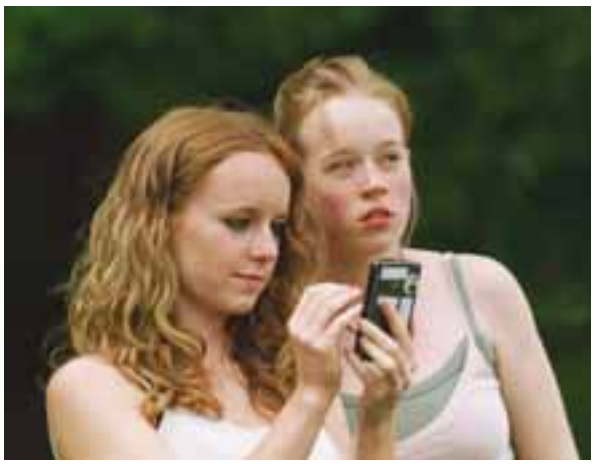

used for presentations and this was felt to be very powerful as a teaching and learning tool.

Generally, schools found the devices selected for this project unreliable; many of them broke. Long repair times exacerbated this situation and prevented whole class activities taking place, contributing to a growing frustration with the initiative. However, it also raised awareness of the need for technical support and some spare capacity.

It is worth noting that, even where schools stopped using the handhelds in a structured way, some of the students still used them for diarising and self-organisation. In the primary sector this was seen in a positive light but in the secondary sector the staff did not see this as particularly useful.

Further information

The Guardian: Miniature computers are adding up to fun
Palm computers are conquering the classroom, and students in Dudley are among the first to test the educational value of these clever gadgets, writes Phil Revell.
education.guardian.co.uk/elearning/story/0,,1314016,00.html

Times Educational Supplement: Handheld learning comes of age
John Galloway reports from the Handheld Learning 2005 conference at Goldsmiths College, London.
www.tes.co.uk/2146164

The Dudley Challenge
A web-based, problem-solving challenge based on a 'virtual' air balloon journey.
www.edu.dudley.gov.uk/c2000/europa/cEuropa/

Dudley Virtual Resource Centre
This site contains a limited set of content available to DGfL users.
www.edu.dudley.gov.uk

Dudley Metropolitan Borough Council: Top technology for Dudley schools
Dudley Grid for Learning (DGfL), part of Dudley Council, is leading on a project which will see teachers and pupils at schools across the borough benefit from the latest hand held technology.
online.dudley.gov.uk/news/fullrelease.asp?recid=919

03 case reports on four handheld learning projects

Learning2Go Phase 2 - Wolverhampton LA

Device type:
Fujitsu Siemens Pocket L00X 720

Connectivity:
wifi

Device ownership:
personal ownership model

Number of students:
1,000+

Introduction and context

Wolverhampton Local Authority wants to improve ICT skills across the city and believes that the personal ownership of handhelds could contribute positively to this by increasing collaborative learning and consequently raising standards (as measured in SATs scores). Additionally, the LA aims to reduce the digital divide, foster links between home and school and enable student enthusiasm to lead innovations in learning and teaching, thus helping to embed ICT within the curriculum.

Main aims of the project

The overarching aim of the Learning2Go project was to explore the pedagogical aspects of implementing handheld technologies as collaborative tools, leading to ubiquitous computing. The participant schools (both primary and secondary institutions) aimed to discover the potential of handhelds when distributed as a personal, owned resource. The learners had total ownership of the devices for use both at school, and at home. Schools had diverse aims which included: to discover the potential of the handheld as a ubiquitous tool for Year 6 pupils and to increase parental involvement with school-based learning as a result; to allow children to share and have the opportunity to use the handheld whenever they deemed it appropriate; the provision of 24/7 access to technology via handhelds to encourage student independence and motivation; to raise standards in mathematics and impact positively on attendance, punctuality and behaviour; to increase access to ICT, develop a positive attitude to learning by the students and raise SATs results; to widen access to ICT; to increase ICT in the curriculum with a view to raising standards in KS3 science SATs; to allow for collaborative learning and provide fun, thus encouraging pupils to take responsibility for their own learning.

What happened?

The project started with a small-scale pilot in Phase 1 working with a small number of schools. The project was built on partnerships between Wolverhampton teachers, the City Council, Espresso Education,

Dave Whyley – Learning2Go

Fujitsu Siemens and Steljes, with the aim of drawing together the educational concerns of teachers with the provision of appropriate software, hardware and technical support. Use of the LA's existing educational content provision meant that multimedia content was available for the handhelds, and also that teachers were using a format with which they were already familiar; consequently, little or no cultural resistance was found to the use of either the materials or the devices. Indeed this partnership was so successful that it won a Becta National ICT Best Practice award in January 2006.

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Dave Whyley – Learning2Go

Phase 2 of the project was launched in November 2005; teachers from Phase 1 helped to embed the use of handhelds in Phase 2 schools and the project has now distributed approximately 1,000 devices to 18 educational establishments. Technical support for the project was undertaken at an LA level by a dedicated handheld technical project manager and at a school level by the schools' technicians, available half a day per week, or through equivalent individually purchased external support. Devices that could not be repaired were sent back to the supplier and returned to the school within a seven-day period.

Two different purchasing models were used throughout the project. In Phase 1, the devices were largely funded from a budget created by the Wolverhampton Schools' Partnership Board. In Phase 2, in addition to school ownership of devices, an assisted contributions scheme was implemented whereby parents were invited to make weekly payments for the use of their child's handheld. This was enabled by the involvement of the e–Learning Foundation. The handhelds were available for purchase at low cost at the end of the project and this scheme allowed some students to retain the devices.

Did the project achieve its goals?

Learning2Go is not intended to be a one-off initiative. Instead, there is an expectation that it will be a pathfinder project whose ultimate aim will be to find a model whereby the use of handhelds can be sustained and embedded to provide ubiquitous access to ICT for all.

This project set out to integrate the handhelds with the existing hardware, software and systems operating in the schools and as part of the general authority ICT provision. The handhelds used were designed to be compatible, for example, with schools' interactive whiteboards, enabling shared viewing of teacher and student machines, and to use software familiar to both pupils and teachers. This stable base has also acted as a firm foundation for more experimental work. Some schools have explored new methods of data collection and the use of video in particular has been widespread. Cameras are seen as an essential part of the devices. Others have explored the use of voting software with free text input, collaborative learning systems and geographic information systems including GPS and mapping software on field work.

Technical support was available to different levels in all schools. This was important in determining the degree of successful implementation of the project. The primary schools, which paid into a service level agreement (SLA) for their technical support, were generally satisfied with this provision, though clarification was needed as to who takes responsibility for the administrative tasks involved with this process. However, the secondary schools, which provided their own technical support, were finding it an onerous task. In this initiative there were few difficulties with the robustness of the handhelds and there were few breakages or device failures.

All schools had access to a wifi network, though some experienced a little difficulty in ensuring comprehensive coverage. Schools had yet to develop a complete system for storage of pupils' work, though the provision of SD cards was an important step in this direction. Schools were investigating the PAAM system to store and manage children's work but nowhere has this been fully explored and no school could yet point to the virtual equivalent of a pile of exercise books as a record of work done on the device.

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Participant schools all had their particular 'champions' for this project and this was of paramount importance in ensuring ongoing enthusiasm, support and expertise within the schools. Visible and active support from the senior management teams was also vital in order to facilitate release for training and to support the risk-taking that any innovation will inevitably require. The loss of champions, however, potentially threatened the sustainability of the use of the handhelds in a school. This risk was reduced when champions were supported and encouraged to share expertise with a critical mass of teaching staff in each school. In the project, the primary sector received regular and adequate training, and dissemination within and between schools was active. The project did identify the need for more tailored support for secondary schools, in order to ensure that training and development was specifically related to the needs of the complex infrastructure and practices for secondary schools.

From the outset, the project aimed to enable use of the handhelds in the home by children and their families. Children personalised the handhelds and used them for diverse non-school related activities as well as for homework tasks (which were sometimes perceived as more interesting than doing homework without the handheld). There is some evidence that the handhelds were used by a variety of family members and that some schools used the devices as a way of communicating with parents.

In terms of facilitating new approaches to teaching and learning, the project highlights a range of different practices emerging. For example, in each class, expert users emerged who experimented with their devices and found new applications for them which they then shared with their teachers and class members. Some teachers actively encouraged and promoted the role of learners as teachers and mentors of other students. This suggests that the handhelds (in conjunction with active support from teachers) can be successful in encouraging collaborative learning communities. Sharing was also in evidence in other lessons where teachers attempted to overcome the lack of sufficient handhelds for all students (with less success in stimulating new forms of learning than when collaboration was actively and intentionally promoted).

While we see the emergence of more collaborative learning approaches in some classrooms, the potential for handhelds to facilitate fully learner-centred activity has yet to be realised in all cases. This is understandable in a relatively new initiative and in a context where new pedagogies are likely to be perceived as risky. The current promotion of more integrated work in the primary school and the changes to the Key Stage 3 curriculum are likely to support the kind of pedagogic shift within which all aspects of the potential of the handheld in teaching and learning will be recognised as positive. At the same time, where there are shifts in pedagogic practice, there are challenges for students who need to be alert to keep up with shifts in management of learning, as the teacher moves from traditional Q&A to handheld-based enquiry.

At the present time, and after a substantial period of experimentation, enthusiasm for handhelds among project students and teachers appears undimmed. The Learning2Go project is clearly breaking new ground and although it cannot yet provide all of the 'answers' it is apparent that this is a project to watch.

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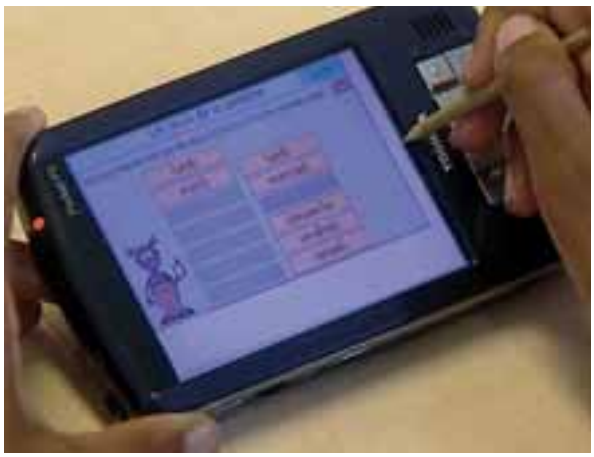

Dave Whyley – Learning2Go

Further information:

Espresso Education – Learning2Go
Innovative learning project wins national award for Wolverhampton City Council and Espresso.
www.espresso.co.uk/news/press_releases/051026_wolves_pda.html

Microsoft Case Study Link
Wolverhampton City Council mobilises learning to give students access to anywhere, anytime education.
www.microsoft.com/resources/casestudies/CaseStudy.asp?CaseStudyID=16914

Wolverhampton Learning2Go
An overview and update with project reports, downloads and videos.
www.learning2go.org.uk

Becta Award 2005 (Wolverhampton City Council Press Release)
Innovative learning award for Wolverhampton.
www.wolverhampton.gov.uk/government_democracy/council/documents/news/press_releases/2005/november/011105c.htm

Handheld Computers (PDAs) in School
Report March 2003 David Perry.
www.becta.org.uk/page_documents/research/handhelds.pdf

I was pants at IT
Report August 2005 David Perry.
wgfl.wolverhampton.gov.uk/PDASite/content/docs/dpa%20Report%2011.pdf

To develop a collaborative, self-supporting community of practice, adequate and appropriate training is a fundamental part of any successful project.

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Warren Comprehensive School

Device type:
mixed- Tungsten C; Dell Axim

Connectivity:
wifi

Device ownership:
distribution model

Number of students:
50+

Introduction and context

Warren Comprehensive School, in Romford, London, is a mixed, non-denominational secondary school with approximately 1,350 students on roll. The school is part of the Becta-managed ICT Test Bed project, which aims to:

"...determine how the use of ICT can raise standards in schools and colleges, gather evidence about how ICT can bring about significant improvements in all aspects of educational endeavour, and successfully disseminate the lessons learnt from the project." (Becta 2005)

The school received a considerable grant from the DfES as part of the ICT Test Bed project and has excellent ICT facilities with wireless access throughout the school. This grant also provided funding for the handheld project, with the art department working with StreetAccess Software Company and Dulwich Picture Gallery to try out new ways of using handhelds in teaching and learning.

Main aims of the project

The project was born out of a need to improve students' critical thinking skills in relation to the art curriculum. Key to the project was the head of the school's art department, who wanted to provide a framework through which the students could learn to ask questions of art. The head of art's knowledge of teaching and the art history expertise of the Dulwich Picture Gallery were combined to provide interactive computer-based lesson material. The project aimed to establish whether an understanding and appreciation of artworks seen in a gallery, through access to appropriate content, in context, via a handheld, might be enhanced by use of the technology, as well as improving students' critical and analytical skills. In this sense, the project had a very specific focus and set of objectives.

What happened?

In conjunction with Dulwich Picture Gallery, which had a wireless network installed, and StreetAccess Software, this partnership resulted in:

"...teacher and gallery educators creating lessons and study material – 'Trails' – that can be accessed on wireless PDA computers using students' direct experience of paintings in the gallery as the starting point." (Warren School 2004)

Students in Years 10–13 (approximately 50 students) had access to approximately 10 handhelds, which were used as a shared resource (class sizes did not generally exceed 10). These devices did not have audio and video facilities, although, in an observed lesson, the students used their mobile phones to take pictures which were then transferred to a computer for later use. In this way, the students extended the functionality of the devices but, when questioned, they

ITC Test Bed project

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were keen to have these facilities available to them on the handhelds and suggested that they could then make notes via voice recordings when on field trips. Indeed, student enthusiasm for the project was apparent in all observations of, and discussions with, them. Handhelds were used to access the trail, which provided contextual information relating to the artists and their work. Students were questioned on the paintings, their responses were entered into the handheld in situ, transferred to the school's learning environment and accessed via each student's personal workspace through the internet at home or at school.

Here, responses were edited, refined and used in electronic 'sketchbooks' or presentations. Additionally, books of 'design sheets', for example in relation to dress in the period studied, were made to accompany the use of the handhelds, thus extending the activity.

Within the school, further work with the handhelds was being developed for PE in the area of fitness technology. In this environment, which did not have PCs, the handhelds could be used in a natural setting with an authentic purpose. The handheld devices offered students the ability to input personal fitness data and maintain a log of their personal progress, which contributed to their subject coursework. Additionally, the provision of hyperlinks within the software allowed for investigation of physiological questions such as why their breathing rates changed during physical activity. The ratio of handhelds to students was 1:3 but it was hoped that the number available would increase. One of the limitations of the software, however, was that it did not link to a database and so the school was designing its own system to allow for this. Additionally, there was concern over issues of copyright with some of the material that might be used.

Future plans include the implementation of trails for use within dance and use of 'Easylink', which enables web-based access to the school's learning environment, thus allowing for access from home.

Ellie Burkett, Dulwich Picture Gallery

Did the project achieve its goals?

The project aimed to use technology to enhance student understanding and appreciation of artworks, as well as developing their critical and analytical skills.

Project progress indicators included use of assessment procedures from the art curriculum, as well as comparing results with the results of the previous two years. The comparison was very favourable and the head of art believes that the aims of the project were met. She also recognised a shift in student/teacher relationships, with a more equitable and collaborative relationship developing, along with an increase in student confidence. One A-level student created her own trail (for use in junior schools) as part of her coursework.

Despite the fact that the school was fully wirelessly connected, the connection proved problematic and unreliable. Largely, in-house technicians dealt with arising problems but the issue remains unresolved. This matter was complicated by the fact that three different tiers of administration, together with three different organisations, were involved in implementing the technology. Because the school has encountered technical problems, staff feel it is important that lessons can stand alone, should the technology fail them, though this adds to the preparation load.

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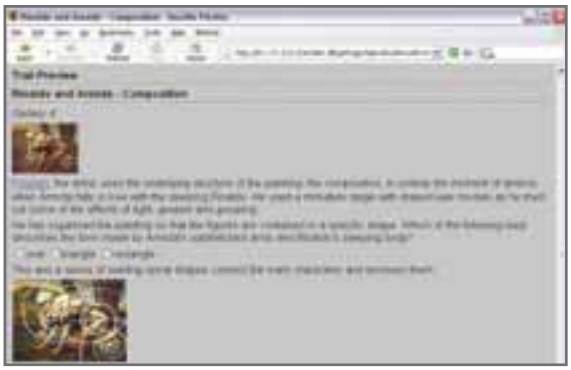
Currently, ownership of the project is limited to the head of the art department, the head of the PE department and the coordinator of the ICT Test Bed project within the school. Training is required for those teachers who are not yet involved in the project, including the provision of ideas as to how they might use the technology in different subject areas in ways that will embed the activity within the curriculum and enhance teaching and learning. The commitment, effort and time demands made on teachers wishing to develop their own trails are also problematic and, again, may serve to dissuade them from embarking on this venture.



Ellie Burkett, Dulwich Picture Gallery StreetAccess Ltd.

The LA deemed this project sufficiently successful that a similar project for infant, junior and secondary phases across the borough has been initiated, developing educational content for use in science, history and geography. Geography trials will use GPS in a local nature reserve. Trails for history will follow the same model as used with Dulwich Picture Gallery; Valence House Museum will provide the local history knowledge and resource base for these trails, which will focus on history, art history and citizenship aspects of the curriculum. However, audio and video material will also be available on these trails, which will be written by the teachers involved. The head of art has been seconded to the project for two days a week. However, it is anticipated that some parts of the new project, which will be using Dell Axims, rather than Palm Tungsten Cs, will follow a different model from that currently used by Warren Comprehensive School's art department.

Further information

The Barking and Dagenham PDA Project
Project website.
www.barking-dagenham.gov.uk/9-cias/ict-team/ict-team-pda.html

Education Telegraph
A new look at old masters.
www.telegraph.co.uk/education/main.jhtml?xml=/education/2004/12/31/teftext01.xml

Education Guardian
The children take a more active role.
education.guardian.co.uk/screencheck/story/0,,1745946,00.html

ICT Test Bed Project Accelerating Change
News archive.
www.bardaglea.org.uk/testbed/tb-news-archive.cfm

Becta ICT Test Bed Evaluations
www.evaluation.icttestbed.org.uk/action_research.cfm

Dulwich Picture Gallery
www.dulwichpicturegallery.org.uk

SteetAccess Software
Discussion of 'trails'.
www.streetaccess.co.uk

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Stiperstones School, Shropshire

Device type:
Dell Axim PDAs

Connectivity:
none

Device ownership:
personal ownership model

Number of students
54 (approximately)

Introduction and context

Stiperstones CE Primary School in Snailbeach, Shrewsbury, is a small, mixed, Church of England school, in a rural area. There were 51 pupils on roll in January 2005 and the age range was 5-11 years. OFSTED reported:

"Stiperstones is a very happy school, and pupils greatly enjoy their time there. Some lessons start early because the children are so keen to get started."

The head teacher believed that the school environment resulted in the children attaining high educational standards, with 98% success in SATs over the past three years. Success was not only experienced in the core subjects but also in art, design technology, information technology, modern foreign languages and music. The school perceived itself as very ICT-literate and the head teacher wanted to facilitate a situation whereby all children had access to a computer both at home and school. The school was responsible for installing 10 internet PCs in a nearby pub, so that residents had access to technology.

The head teacher had strong views both on learning and the use of ICT in schools. For example, the school uses a matrix combining Bloom's Taxonomy (Bloom 1956) of thinking levels and Gardner's Multiple Intelligence

Theory **(www.infed.org/thinkers/gardner.htm)** so that teachers have a planning tool that caters for learning styles and challenges thinking.

"I don't look at planning, but I'll say to [teaching staff] 'Look there's two musical learners in this class, what have you what have you done for them in numeracy this week to engage them as learners?' Because if they haven't done anything to engage them then they're disadvantaged. It goes back to this equal opportunities I suppose, they've disadvantaged those children."

He believes that, just as it would be inappropriate to have a scheme of work for pencil use, so it would be inappropriate to have a scheme of work for the use of technology. Rather, he combines the use of technology with learning theory, asking in what ways technology can contribute to the needs of learners with varying learning styles, concluding "when you look at the PDA... it's a very powerful tool".

Main aims of the project

The head teacher believed very firmly in the importance of equality of access and opportunity, and the underlying rationale of the project was to provide equality of access and widened participation, not only for students but also throughout the wider community. Additionally, the head

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teacher had noticed that the boys lacked engagement and motivation with literacy activities. He hoped that the technology might act as a motivational tool for these students, thus increasing their engagement with literacy.

What happened?

The head teacher was responsible for initiating and implementing the handheld technologies project in the school, where approximately 54 Dell Axim PDAs were distributed to staff and students. Each Key Stage pupil 'owned' a device for use as a personalised tool. Staff were provided with devices to use as and when they deemed it appropriate. Some spare machines were available to cover breakage and loss.

Parents seemed to be accessing more ICT, perhaps encouraged to do so because all newsletters and the school diary were sent home electronically. The initial training was seen as an important factor in parental uptake.

Rather unusually, perhaps, the handhelds were not synchronised with a PC but, instead, were used as stand-alone tools. However, work was beamed between students, and between students and staff, thus enabling collaborative activities. The handhelds were also connected to data projectors, to facilitate collaborative writing. Whilst the handhelds were used across the entire subject range, there was a focus on using them for various literacy activities and activities designed to develop critical thought. For example, buildings on skills learnt at Key Stage 1 ('plan, do and review') handhelds were used to support students in planning, executing and reviewing their work. Additionally, whilst specific activities were undertaken using the handhelds, students had full ownership of the devices and used them both at school and at home as they saw fit, taking control of their own learning.

In the lower part of the school, handhelds were used by teachers as an administration tool, for the compilation of baseline information assessments, which were then sent electronically to the LEA. However, this was seen as a quite separate activity from the use of the handhelds as a teaching and learning tool.

This project lasted for three and a half years, finishing at the end of the summer term, 2005. Generally, the devices were felt to be sufficiently robust though some problems were encountered when newer 'improved' models were distributed as these were less robust than the older versions; however, the suppliers were able to replace these with the original versions, thus solving the problem. Few breakages were suffered and when this did occur, replacements were found very quickly – consequently, device breakage did not impact on the project. Neither did the head teacher feel that use of the handhelds impacted particularly upon teacher workload, perhaps because all staff were enthusiastic about the project and took ownership of their devices, using them as a personal tool, as well as a teaching and learning device.

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Did the project achieve its goals?

The project aimed to encourage student motivation and engagement with literacy, as well as improving community access to technology. In assessing this project, the head teacher believed that it had succeeded in empowering both students and parents. Boys' literacy skills improved (particularly with non-fiction genres and particularly with boys in Years 3 and 4). Students read and wrote longer and more complex texts and motivation was heightened. This was not restricted to the boys; girls also showed improved literacy skills and greater motivation, and the head teacher felt that it was the more able female students who benefited most from using the handhelds. Yet, conversely, the handhelds proved to be a very effective writing tool for special needs students, improving their ability to communicate effectively. Other findings included heightened student self-esteem, an increase in reading (particularly boys) and a general improvement in the students' ICT skills and ability to manipulate information.

Interestingly, the head teacher felt that standards achieved when using the handhelds for fictional genres were actually lower than they might otherwise have been. Though the reasons for this were not clear, he warns that this technology is not necessarily effective for all activities, or for all students. Additionally, whilst the portability of the handhelds was helpful, a lack of software availability resulted in a product which was considered to be inferior to a PC. Indeed, the main difficulty encountered through the project centred on insufficient software availability and, ultimately, this led to its conclusion at the end of the summer term, 2005.

Overall, the project, which was informally assessed, was felt to be very successful but, given the driving force of equality of access to technology, and the head teacher's view that handhelds are unable to function as a suitable replacement for PCs, the school is currently equipping all of its students with laptops, and home broadband access.

Further information

Switchon Shropshire
Broadband access for businesses and the community of Shropshire. Case study: Stiperstones Inn.
www.switchonshropshire.org.uk/public/sos-community.nsf/pages/case-study-stiperstones-inn

04 directory of handheld learning projects and resources

The projects listed below were identified through a literature review that searched conference papers, journals, research reports, news items and the web pages of projects and their associated commercial and non-commercial supporting bodies. Contact information shown here was already available on the web, or has been provided for inclusion by the individuals involved.

Project title & information	Institution and support bodies	Information sources and contact details	Age range	Devices used	Time scale	Country
24/7 Learning Using handhelds to improve literacy and numeracy skills through working at school and at home. It aims to help different learning styles and improve independent and collaborative learning.	ITSS at Durham LA Selected schools	www.durhamlea.org.uk/pda/ Paul Hodgkinson, Curriculum Team Leader, Information and Technical Support Services (ITSS) Paul.Hodgkinson@durhamlea.org.uk 01388 424999	9-10	Fujitsu-Siemens Loox PDAs with Windows 2003	2006-2008	UK
Hand-e-Learning: Bristol Primary PDA Project Enabling children to have '24/7' access to ICT, the handheld device becoming a ubiquitous tool to support personalised learning across the curriculum, at home, school and for fieldwork. Device also being used as feedback tool using Turning Point 'VPad' voting system and for creating mediascapes.	CLC@Brislington CLC3 Bristol Bristol LA	www.clcbristol.org.uk/hand-e/ clc3pdasupport@bristol-city.gov.uk Lucinda Searle ICT Advisory Teacher Bristol LA New Technologies Advisor CLC@Brislington lucinda_searle@bristol-city.gov.uk 0117 3772500 0117 3773225	8-12	Fujitsu-Siemens Loox PDAs with Windows 2003	2006-2008	UK
Redcar and Cleveland The focus is on developing independent learners who can access information and author work 24/7. The project hopes to integrate the devices into the children's adoption of a Learning Platform for organising personal work as well as taking part in a shared online community.	Three schools in Redcar and Cleveland LA supported by the LA ICT Centre	Andrew Stogdale Learning and Teaching Consultant andrew@lea.rac.sch.uk 01642 286688	9-11	Fujitsu-Siemens Loox PDAs with Windows 2003	2006-2008	UK

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Project title & information	Institution and support bodies	Information sources and contact details	Age range	Devices used	Time scale	Country
Learning Everywhere: The Bradford PDA Project Handhelds used in lessons to take notes, complete homework, keep a diary calendar, review resources on school networks, send and receive e-mail, access the internet for information and revision. Students can also use the handheld for storing music and photos and playing games. Future development aims for further integration of handhelds into the curriculum eg in science, visits and GPS.	City Learning Centre at Carlton Bolling Secondary School Buttershaw Secondary School	www.citylearningcentre.co.uk/learningeverywhere/index.html Dr Alan Beecham, Secondary Strategy Consultant, Bradford (contact through the City Learning Centre) info@learningeverywhere.org 01274 770264	14 -15	Dell Axim x50v with wireless and Bluetooth, full VGA screen, Data Harvest Flash Logger	2005-2007	UK
Aston Pride REAL PDA Project Content is available through the school network and pupils can save visual, audio, drawings and notes of their own choice as an aid to writing or multimedia presentation. Self-assessment is also being considered. Home participation is promoted.	Birmingham City Council European Union Birmingham REAL (Raising Expectation and Achievement in Literacy) Project Deykin Avenue Junior and Infant School Yew Tree Community School	www.astonpride.com/index.cfm?s=1&m=40&p=51,index www.bgfl.org/bgfl/22.cfm?s=22&m=1755&p=533,index&zs=n Paula Edmondson, REAL Officer, Aston Pride paula.m.edmondson@birmingham.gov.uk 07713 090054 Keith Edwards, E-Innovations Manager and REAL Project Manager keith_edwards@birmingham.gov.uk	9-10	Fujisu-Siemens Pocket LOOX 720	2005-	UK
Hand Held Technology Project Using handhelds to plan, mindmap, view simulations, collect and analyse images and data in KS4 science.	CLC3 in Bristol with Henbury and St Bernadette's Secondary Schools	www.clc3bristol.org.uk/Pages/gcse.html (bottom of page) Sheila Crew, Director CLC3 sheila_crew@bristol-city.gov.uk 0117 3773370	14-15	550 Fujitsu PDA with integral cameras	2006-2008	UK

04 directory of handheld learning projects and resources

Project title & information	Institution and support bodies	Information sources and contact details	Age range	Devices used	Time scale	Country
Social Tapestries Project This project looks at a cross-curricular approach to learning through handhelds which can be integrated into the curriculum. Jenny Hammond School is developing it on the ground in 2006-7.	Proboscis SoMa research initiatives Jenny Hammond Primary School	socialtapestries.net/research/jennyhammond.html	5-11	Unknown	2005-2007	UK
Glasgow Goes Mobile Notre Dame High School has used handhelds for homework, writing, note-taking and voice recording. They are now moving to using them for individual and collaborative internet projects.	Glasgow City Council Notre Dame High School (All Saints Secondary School, Cleveden High School and St Mary's Primary School are also part of the council project)	www.ltscotland.org.uk/ictineducation/connected/archivedissues/connected4/ict/jornada.asp (scroll down to find the article) Neil McDonald, ICT Coordinator, Glasgow City Council neil.mcdonald@education.glasgow.gov.uk Isobel Taggart AHT, Notre Dame High School isobel.taggart@virgin.net	11-16	Hewlett Packard Jornada handheld computers	1998-2006	UK
Palm Handheld Integration Project (TICTOC) A consortium of remote rural schools are using handhelds to support pupils, many of whom do not have computers or internet at home. Through using handhelds, many pupils have been encouraged in maths and the pupils in English have used e-books, note-taking and writing essays.	Superior, Montana and other Western Montana towns and Montana University	solutions.palm.com/regac/success_stories/education/education_details.jsp?storyId=1256 Diane Woodard Technology Coordinator Superior Public Schools Project Lead - Palm Handheld Integration Project	5-18	Palm Tungsten handhelds and keyboards	2005-2006	USA
Create-A-Scape Cross-curricular activities where learners create audio-visual landscapes to overlay physical space using handhelds and editing software. Schools post their experiences on website.	Futurelab Open to all schools	www.createascape.org.uk Clara Mortimer, R&D Project Manager, Futurelab clara.mortimer@futurelab.org.uk	5-18	Various	2006-	UK

04 directory of handheld learning projects and resources

Project title & information	Institution and support bodies	Information sources and contact details	Age range	Devices used	Time scale	Country
Paperless Classroom for Biotech Course The handhelds are used to submit assignments, gather data using probes, keep notes, access internet for documents, class information and conferencing.	Ancaster High School, Ontario	solutions.palm.com/regac/success_stories/education/education_details.jsp?storyId=337	17-18	PalmOne M130	2005	Canada
Eduvision Pilot Project Pupils use handhelds as textbooks with video and audio facilities. The aim is to also use them as exercise books for work that can be sent directly to the teacher.	Mbita Primary, Kenya	news.bbc.co.uk/1/hi/programmes/click_online/4727617.stm	11	Pocket PCs	2005	Africa
Student Centred Learning Project In English the pupils use the handhelds for listening to their own reading, making rough drafts of their work, using concept mapping tools for planning and using the camera to make nature notebooks. They send each other their work for peer assessment. The teacher aims to facilitate the different learning styles by making the pupils more independent.	South Fayette Elementary School, Pennsylvania	solutions.palm.com/regac/success_stories/education/education_details.jsp?storyId=1201 Scott Sundgren South Fayette Elementary School South Fayette Township, PA	8-9	Palm Zire handhelds with keyboards	2005	USA
Moop Project This is an interactive m-learning environment for primary school pupils to analyse their surroundings and to communicate within groups.	Department of Education, City of Oulu Patamäki Primary School, Oulu	www.mlearn.org.za/CD/papers/Mattila.pdf Pasi Mattila pasi.mattila@ope.ouka.fi Timo Fordell timo.fordell@ope.ouka.fi	10-12	Camera phone	2005	Finland
Access and Equity Project The school is for French-speaking pupils in an English-speaking part of Canada. The handhelds are used to help with language as well as the more usual support with writing, maths and science.	Le Rose Sauvage Public School, Calgary	solutions.palm.com/regac/success_stories/education/education_details.jsp?storyId=339	12-17	Palm Tungsten T handhelds with multilingual keyboards	2005	Canada

04 directory of handheld learning projects and resources

Project title & information	Institution and support bodies	Information sources and contact details	Age range	Devices used	Time scale	Country
Empowering Learners: Mobile Learning and Teaching with PDAs Dewsbury College aimed to provide outreach centres with the same learning resources as the main centre. Thomas Danby College wanted basic skills learners to be able to work at their own pace. Bishop Burton College aimed to collect data outside the centre for later analysis.	JISC funded at Dewsbury College, Thomas Danby College, Bishop Burton College	www.elearning.ac.uk/innoprac/practitioner/dewsbury.html www.elearning.ac.uk/innoprac/practitioner/resources/dewsbury.doc Janet Pittaway, Assistant Principal, Dewsbury College	Post 16	HP 2210 iPAQ Pocket PCs HP Jornada 565s	2004	UK
Computer Supported Collaborative Learning Project This looks at collaborative activities in K to12 ranging from Maths to Language with the aim of developing social and communication skills	Universidad Católica de Chile Funded by: FONDECYT FONDEF Microsoft Research HP DIPEI	Zurita G, Nussbaum M, (2004). Computer supported collaborative learning using wirelessly interconnected handheld computers. Computers & Education Vol 42-3 pages 289-314 Abstract: portal.acm.org/citation.cfm?id=987104&dl=ACM&coll=&CFID=15151515&CFTOKEN=6184618	6-18	Pocket PC, Compaq iPAQ with 64MB RAM	2004-2007	Chile, Argentina, Brazil
Learning Lab: Inclusive Education using Mobile Devices Pupils used mobile phones with cameras for problem solving outside. They used GPS to map their route to school and then enhanced their maps with pictures and captions associated with their movements and lives.	Learning Lab team (CKS), Bangalore and New Delhi	www.hhrc.rca.ac.uk/events/include/2005/proceedings/pdf/soodadityadev.pdf#search=%22Learning%20Lab%3A%20Inclusive%20Education%22	13-15	Mobile phones, cameras and GPS	2004	India

04 directory of handheld learning projects and resources

Project title & information	Institution and support bodies	Information sources and contact details	Age range	Devices used	Time scale	Country
The Sebastian Elementary School Project The aim was to improve maths and English. The pupils used the handhelds for word processing, concept mapping, drawing, animation, and the downloading.	Sebastian Elementary School, India-River, Florida	solutions.palm.com/regac/success_stories/education/education_details.jsp?storyId=1296	9-10	Palm Tungsten handhelds with keyboards	2004	USA
iPod Language Initiative Because of the lack of space for language labs, the school used iPods that could be used anywhere instead.	The Brearley School, Manhattan, NY Apple Education	www.apple.com/education/profiles/brearley/	11-18	iPod	2004	USA
TEEMSS (Technically Enhanced Elementary and Middle School Science) Project This looked at the feasibility of using handhelds with probes for science. The criteria included cost, teacher development and quality of guidance materials. Two units were developed related to forces and energy transfer.	The Concord Consortium National Science Foundation, USA	www.concord.org/publications/detail/2003-narst-teemss.html www.concord.org/publications/files/narst_teemss_paper.pdf teemss1.concord.org/pdf/teemss-r-d.pdf Shari J Metcalf and Robert F Tinker, Journal of Science Education and Technology, Vol 13, No 1, March 2004 Shari J Metcalf shari@concord.org	9-14	Palm and CCLabBook software	2002-2004	USA, Australia, Israel
TARGET PAALM Grant Project The use of software on handhelds to encourage motivation in maths and English provides immediate feedback to learners.	TARGET and PAALM grants, Region 16, Texas	solutions.palm.com/regac/success_stories/education/education_details.jsp?storyId=1377	8-11	Palm handhelds and keyboards	2003-2006	USA

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Project title & information	Institution and support bodies	Information sources and contact details	Age range	Devices used	Time scale	Country
Looking After Literacy Initiative Pupils who were in public care and in need of support in developing literacy skills were targeted. Home visits and support with reading were also part of the project.	National Literacy Association The Who Cares? Trust Kent County Council	www.dfes.gov.uk/educationprotects//upload/ACF12F7.doc www.literacytrust.org.uk/pubs/wolfendale.html www.literacytrust.org.uk/socialinclusion/children/kent.html Professor Sheila Wolfendale and Trevor Bryans	9-14	PSION 5mx	2002-2003	UK
A New Sense of Place Investigating how wireless technology can influence children's perception of virtual and real spaces and help them to re-engage with their own environment.	Ashton Gate Primary School Mobile Bristol	www.mobilebristol.com/flash.html www.ordnancesurvey.co.uk/oswebsite/partnerships/research/publications/docs/2004/p32mobilebris_geo.pdf Constance Fleuriot, Owain Jones (University of Bristol) Morris Williams (University of the West of England) Lucy Wood (Ordnance Survey)	9-10	PDAs, GPS, HP research ideas	2002-2003	UK
Tablet PC Project Overall the project aimed to improve teaching and learning in primary schools. St Brigids RC Primary considered how the PC tablets helped the learning of the gifted and talented in Year 6 (10-11 year-olds)	East Manchester Education Action Zone	www.digital-think.info/brproj/BrigidsPhase2.pdf www.dlink.com/business/casestudies.asp?cid=4&scid=0&csid=19	10-11	Tablet PCs	2002-2003	UK
The Paperless Classroom, Eminence Pocket PC Project Handhelds are used in language arts (English) classes. Initially it was set up to help ESL pupils with homework and reading but it is continuing as it helped all the pupils.	Eminence Middle School, Kentucky	www.paperlessclassroom.org stephsorrell@hotmail.com	12-14	Compaq 2100, 1500s; HP Jornada 420, 430s; Casio Cassiopeia 125s, 500m	2000-2003	USA

04 directory of handheld learning projects and resources

Project title & information	Institution and support bodies	Information sources and contact details	Age range	Devices used	Time scale	Country
iPAQs for Improving IT Skills Handhelds were introduced to the school to improve both students' and teachers' ICT abilities as well as exam results. They also wanted to consider if handhelds could improve learning generally.	Philip Morant School and College Microsoft	members.microsoft.com/CustomerEvidence/Search/EvidenceDetails.aspx?EvidenceID=1339&LanguageID=1 www.becta.org.uk/page_documents/research/handhelds.pdf Steve Goodridge, Project Leader, Philip Morant School and College	11-18	iPAQs	2002	UK
PDAs in PE Handhelds have been used by PE pupils to monitor body fat because they can be used in the field and retain data for analysis.	Arnewood School, New Milton	www.ict-register.net/browse.php?action=one&id=197&sch_id=47 www.becta.org.uk/page_documents/research/handhelds.pdf	15-18	PDA unspecified	2002	UK
PDAs for SEN Pupils Handhelds were provided for SEN pupils to help their organisational skills. Their use gave the pupils status and helped with written work and homework. No handhelds were lost or broken during the project.	Cottage Grove High School, Michigan Hi-CE ISTE	www.isec2005.org.uk/isec/abstracts/papers_b/barrett_b.shtml	11-18	iPAQ 5555	2001	USA
The Rivers Project A comparative project involved two classes; each used the handhelds for part of the year to determine the quality of the river water. Without handhelds most time was spent setting up equipment.	Palm Education Pioneers (PEP) Pekin Community Highschool Illinois	SRI evaluation of the projects: www.palmgrants.sri.com/PEP_Final_Report.pdf (page 6)	14-18	Palm handheld computers, ImagiProbe system, Vernoer probes	2001-2002	USA
Building Vocabulary in the ESL Classroom A 'word wall' was established on the handhelds so that the pupils could carry their personal vocabulary around with them and add to it. They also had a dictionary and thesaurus on the handhelds. It was used in creative writing, maths and science.	Palm Education Pioneers (PEP) Miller Wall Elementary School	SRI evaluation of the projects: www.palmgrants.sri.com/PEP_Final_Report.pdf (page 59)	7-10	Palm handheld computer	2001-2002	USA

04 directory of handheld learning projects and resources

Project title & information	Institution and support bodies	Information sources and contact details	Age range	Devices used	Time scale	Country
Fostering Writing Expertise for Special Needs Students The pupils used the handhelds in English and resource room classes as a substitute for pens. Results showed improvement in quality and quantity of material plus improved self-esteem.	Palm Education Pioneers (PEP) Blauvelt School, New York	SRI evaluation of the projects: www.palmgrants.sri.com/PEP_Final_Report.pdf	9-13	Palm handheld computer, portable keyboard	2001-2002	USA
Electronic Journalism Using Handheld Computers Helped pupils with formulating questions, storing factual information and communicating with teachers. There was a reduction in inaccuracies in facts and English.	Palm Education Pioneers (PEP) Klickitat, Washington, School District Newspaper	SRI evaluation of the projects: www.palmgrants.sri.com/PEP_Final_Report.pdf	14-18	Palm handheld computers	2001-2002	USA
Advanced Physics Using Handhelds The handhelds were used to help understand scientific concepts such as gradients of electronic fields as well as general data recording. The results of the group with handhelds was compared with those without.	Palm Education Pioneers (PEP) University School of Nashville, Tennessee	SRI evaluation of the projects: www.palmgrants.sri.com/PEP_Final_Report.pdf	16-18	Palm handhelds, PalmPix cameras, portable keyboard.	2001-2002	USA
Developing Mental Calculation Skills Through Pattern in Number in Year 4 with Portable Computers The aim was to improve the pupils' understanding of the properties of numbers.	University of Newcastle	www.leeds.ac.uk/educol/documents/00001369d.htm	8-9	e-mates	1999	UK
The Pocket Book Weather Project An investigation of the varying weather patterns across the world. The pupils used PDAs for analysing, graphing and interpreting numerical data.	Open University working with a comprehensive and a grammar school in Buckinghamshire	jime.open.ac.uk/2005/25/scanlon-2005-25-05.html Henessey, S (2000). Graphing investigations using portable (palmtop) technology. Journal of Computer Assisted Learning, 16, 243-258	12-14	Pocket books and palmtops	1999	UK

05 useful links and resources

1. Teaching with Handhelds: Project Ideas to Enhance Learning (2006); Learning with Handhelds, Intel Education Initiative, retrieved 18 September 2006 from:

www.intel.com/education/handhelds/teaching_with_HH.htm

This site contains ideas for teaching with handhelds in humanities, maths, science and social studies.

2. O'Malley, C, Vavoula, G, Glew, JP, Taylor, J, Sharples, M, Lefrere, P, Lonsdale, P, Naismith, L, Waycott, J (2005). WP4 – Pedagogical Methodologies and Paradigms, Guidelines for learning/teaching/tutoring in a mobile environment. MOBIlearn. Retrieved 18 September, 2006 from:

www.mobilearn.org/download/results/public_deliverables/MOBIlearn_D4.1_Final.pdf

This MOBIlearn Project paper contains summaries of case studies and clearly relates them to learning theory.

3. Attwelle, J (2005). From Research and Development to Mobile Learning: Tools for Education and Training Providers and their Learners. mLearn 2005 conference. Retrieved 18 September 2006 from:

www.mlearn.org.za/CD/papers/Attewell.pdf

This conference paper offers helpful pointers for those considering using handhelds in education and discusses the lessons learnt from a major m-learning project summarised in:

Attewell, J (2005). Mobile Technologies and Learning: A Technology Update and M-learning Project Summary. Learning and Skills Development Agency.

www.lsda.org.uk/files/PDF/041923RS.pdf

4. Stead, G (2005). Moving Mobile into Mainstream. mLearn 2005 Conference. Retrieved 18 September 2006 from:

www.mlearn.org.za/CD/papers/Stead.pdf

This conference paper is concerned with lessons learnt through the use of learning resources, pedagogical approaches, support systems and devices and how the knowledge can help progress in the future.

05 useful links and resources

5. Joyner, A (2003). A Foothold for Handhelds: An Inexpensive Alternative to Desktops is Finding a Home in Schools. Special report for the American School Board Journal (ABSJ), retrieved 18 September 2006 from:

www.asbj.com/specialreports/0903SpecialReports/S3.html

This report gives an insight into the development of handhelds as an alternative to desktops. It also gives examples of the types of handhelds being used.

6. The following books are available through the International Society for Technology in Education (ISTE Publications) website **www.iste.org:**

Williams, B (2006). Handheld Computers and Smartphones in Secondary Schools. International Society for Technology in Education (ISTE Publications): Eugene, Oregon

Gramling, A, Curtis, M, Reese, K, Wieczorek, A, Norris, K, Soloway E (2004). Pocket PC Computers. International Society for Technology in Education (ISTE Publications): Eugene, Oregon

Pownell, D, Bailey, GD (2003). Administrative Solutions for Handheld Technology in Schools. International Society for Technology in Education (ISTE Publications): Eugene, Oregon

These all give practical advice and guides to implementing successful projects written from extensive practical experience.

7. The Handheld Learning Website at **www.handheldlearning.co.uk** is the home site for a growing community of practitioners and researchers interested in handheld learning.

8. Handheld Computers (PDAs) in Schools, Report March 2003 by David Perry (**www.becta.org.uk/page_documents/research/handhelds.pdf**) provides a review of the use of PDAs in schools as part of a Becta/DfES pilot and is complementary in its focus to the issues raised in this handbook.

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