

Mobile learning: Research findings

Report to Becta

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Mobile learning: Research findings

Background

This is the first interim report of a development and research project focused on the impact of one-to-one personal ownership of mobile devices. It presents baseline data and emerging findings from the first six months (two terms) of a two-year research project and sets a context for future reports. It will be of particular interest to local authorities and school leaders.

The research took place in three schools within two ambitious projects that enabled all pupils in a year group and their teachers to have mobile devices.

In the Learning2Go (Phase 3) initiative in Wolverhampton, researchers worked with Year 5, and in the Bristol Hand-e Learning project, they worked with Year 10. The research project is planned to continue until September 2008, thus following these learners through a two-year period, ending with a major external assessment point: Key Stage 2 SATs for Year 5 and GCSE for Year 10.

In both cases, the projects were the vision of the local education support service: the local authority in Wolverhampton and one of the city learning centres (CLC3) in Bristol. These teams of professionals have been essential to the projects, providing leadership, staff development, advice and technical support.

The support services recommended which device schools should choose and which content and software to provide. In Wolverhampton, this choice was based on previous experience with mobile learning.

In both Wolverhampton and Bristol, the schools involved were invited to join the projects, and the headteachers showed significant commitment to the vision of embedded use of ICT in the school through the use of personal mobile devices.

In all cases reported here, the devices are funded by parental contributions linked to grants from the e-Learning Foundation. Parents make a monthly payment over a two-year funding period, and the schools administer the collection of these funds. The learners in Years 5 and 10 thus have full-time ownership of the devices, including at weekends and during holidays.

Note: Our use of the term 'mobile devices' relates to portable, mobile technologies which can be held in the hand and used in any location or context. A range of devices are included within this definition.

In this project, teachers and children were given a PDA (personal digital assistant). Each device is equipped with a mobile version of an operating system found on PCs and has an integral camera. The lead agencies in each location also selected

additional applications and content to be installed or made available to the particular user group via an SD (Secure Digital) memory card.

The battery life of each device is one working day. Devices are wireless enabled, and all schools involved have wireless access.

The research

The design of the research project is developmental: the data collected is progressively analysed and findings are fed back regularly to teachers and headteachers for their validation and comment. The researchers' role in the initial phases of the roll-out has been to record the data and provide a mirror. As the project progresses, teachers, as co-researchers, will become increasingly involved in the analysis of data.

Data on attainment, attendance and learner disposition was collected at the start of the project. This provides a baseline for comparison with parallel data-sets to be collected at the end.

In the first two terms, other data sources have included the following: interviews with headteachers, teachers and learners; a pupil survey on personal experience of technology; day-long observations of a group of pupils, supplemented by informal interviews; and periodic week-long pupil diaries. Each of these is scheduled to be repeated each term or at longer intervals across the life of the project.

In the next stage of research, video recordings of learning and teaching episodes will be collected and analysed collaboratively. The range of data provides opportunities for triangulation and the construction of case studies.

The project addressed these research questions:

- What pedagogic models best support effective use of one-to-one access to educational resources and tools via a mobile learning device?
- What impact on attainment and other defined learning outcomes can be linked to this intervention?
- What are the implications of mobile technologies for practitioners, particularly in terms of continuing professional development (CPD), barriers to engagement, and embedding the use of mobile technologies within pedagogy?
- Has there been a quantifiable impact on teachers' productive use of time as a result of this intervention?
- How have the relationships with families and communities been developed through these interventions?
- What are the technical challenges for this kind of access and use, and how have they been met?

Themes and issues emerging from the first six months of research

The findings reported here are drawn from the research in both primary and secondary schools and reflect a range of experiences reported to and observed by researchers.

The evidence drawn on may not come equally from both primary and secondary schools, but these findings are emerging as generally significant in the impact they have on successful implementation and embedding of the devices in teaching and learning.

In identifying emerging themes and issues, the implications from all data sources have been drawn out.

1 Use of mobile devices in teaching and learning

- The initial implementation of mobile learning projects is logistically challenging, requiring careful planning and commitment from all partners. Where mobile learning has been successfully implemented, promising innovative practice is emerging.
- Patterns of use identified so far vary across schools and subjects. A number of factors appear to be implicated in these patterns:

Professional development of teachers

A number of different approaches to teachers' CPD have been tried according to local circumstances. No one model has yet proved to be better than another in terms of the impact of training on practice. However, some elements of the training provided were generally perceived as beneficial:

- Teachers appreciate having time to play with the devices and explore their potential before thinking about using mobile devices in teaching and learning.
- The presence of mentors or colleagues who can suggest materials and/or approaches and discuss outcomes seemed to increase the use of devices.
- Starting small, with activities that are carefully thought through and clearly exploit the possibilities for learning inherent in mobile devices, is effective.

At this stage, there is little evidence of teachers using project-specific websites set up to support the integration of mobile devices.

Some teachers were making effective and innovative use of devices, and others, who appear to have received the same CPD, have yet to make a start. Teachers' background, including their experience of technology, and their attitude to technology seem to be significant in the early stages.

Teachers' confidence, their relationship with their classes and their attitude to taking risks appear to be the factors having the greatest effect on the pace of implementation of mobile learning into teaching and learning. The pace of implementation increased when teachers found material and/or examples that they felt comfortable with.

Provision of software and content on the devices

Teachers' response to the software and content available has an impact on use. In some cases, it proved challenging to communicate to teachers the full richness of what the mobile learning devices offer. When teachers felt they had been consulted about what software was provided, this had a positive impact on their sense of ownership and their capacity to see how the use of mobile devices could be integrated in teaching and learning.

Also emerging as a theme is the number of interconnected factors that have an impact on what software and content is provided. These include the involvement of hardware, software and content providers and the relationships between providers, schools and local authorities.

Management of expectations has proved important, so that everyone involved understands what is available and at what cost. For example, some schools accepted offers of specific software for a trial period. In many cases, pupils responded enthusiastically and became accustomed to using the applications. There were then some problems with validating continued access after the trial period ended.

2 Teachers' time

In a roll-out of any innovation, an investment of time is required in the early stages of implementation.

In this research, teachers thought they needed time to explore the potential of different software applications to support planned learning, and to locate and review available content.

Some teachers thought that once the initial stage was over, time would be saved by having so much available on one device and in the potential of mobile devices for managing classroom activity. The time taken to set up tasks on the device clearly decreases with familiarity and habitual use.

Some teachers also thought that time was required if they were to feel confident when responding to the more-individual and personalised needs of learners, although this is an issue that is wider than the use of mobile devices.

The extent of take-up of mobile learning by teachers will in part depend on the amount of time they are prepared to give to becoming familiar with the device and visioning its full potential for enhancing teaching and learning. The next stage of the research will consider this in more depth and collect exemplification.

3 Teaching and learning

A number of themes are emerging that are of interest in considering how the incorporation of mobile devices might bring about or require different models of teaching and learning. At this early stage, the following findings provide pointers for the ongoing research:

Shifts in pedagogy

- Teachers, especially in the primary phase, were aware of shifts in the way they teach and pupils learn, brought about by the pupils' ownership of mobile devices. These methods are not completely displacing traditional methods, but teachers expressed aspirations for the quite radical changes that they see mobile devices might bring about. These aspirations include more democratic learning environments, changes in teacher–pupil relationships, more pupil autonomy and personalisation in learning.

Learner autonomy

- With increased learner autonomy and personalisation there was a heightened awareness of the need to ensure that pupils have appropriate levels of skill in locating and evaluating resources, critical thinking and reflecting on their own learning.

Motivation

- In common with observations of similar projects, there is evidence that using mobile devices is motivating for most learners. The strength and impact of the motivation varies across the pupil sample. The research will look closely at motivation in terms of variables such as attainment, gender, age and family context.

Learner-directed activity

- There appears to have been some increase in out-of-school learner-directed activity related to the school curriculum, using the mobile devices; perhaps more than has been evident with other less-mobile technologies.

Appropriate use

- Teachers were anxious that increased autonomy in learning should be associated with appropriate use of the mobile device – that it should contribute to the intended learning, especially in classroom lessons.

Assessment

- Tensions are emerging between teachers' increasing understanding of the possible uses of mobile devices and the current forms of assessment of the curriculum. Teachers of pupils at key stages in the assessment cycle – Year 6 and Year 11 – are particularly aware of the expectations placed on them. Some are reluctant to move away from traditional approaches that they think have served them well. Using mobile devices (even in the years preceding these assessment points) was perceived by some teachers as a risk.
- When the research follows learners into Years 6 and 11 it will be well placed to consider this issue in more detail.

4 Emerging models of use

At this stage, three main ways have been observed in which mobile devices are being incorporated by teachers and learners:

Teacher-directed activity

- Here the teacher has a very clear notion of how the device is to be used to achieve the learning objective and also largely determines the outcome. However, within this predominantly teacher-controlled environment, learners may be enabled to exercise some degree of independence. For instance, within a lesson, learners may be allocated time to complete a specific task individually or in groups, and they may use mobile devices as they feel appropriate, rather than as directed.

Teacher-set activity

- This approach is more open-ended in that, although the teacher sets the task and the general outcome, the processes and the format of the outcome are to a large extent defined by the learner. With this approach, learners are freer to use their own ideas and their initiative. It can provide a way of engaging with different learning preferences. Most learners, though not all, take the opportunity to use their mobile devices when offered the option.
- Higher attaining pupils have flourished and provided many examples of using their initiative, relishing the autonomy. However, teachers have noted that many pupils have, for instance, limited learning strategies and lack necessary skills (not always technology related).
- In some cases, these activities have also revealed for some learners the shortcomings of resources installed on the devices.

Autonomous learning activity

- Interviews with learners are beginning to reveal a wide variety of self-directed, school-based learning, especially in primary school.
- Year 5 teachers have reported children doing work unasked. For example, one child developed a way of using her PDA to learn spellings; another used a spreadsheet to explore learning her multiplication tables. Others were accessing content not specified by the teacher, but out of curiosity and interest. One girl found a video of a Teachers' TV programme about pie charts that had been loaded onto her device. She had watched it several times and said that when they did pie charts at school, she would know about them.
- Some secondary pupils have begun to use the mobile devices independently in lessons where there was no use planned by the teacher. Uses include making notes and photographing the white board.
- These examples are directly related to the school curriculum and seem to show a response that is specific to mobile device technologies. The evidence base will be developed. Continued analysis of pupil interviews, diaries and captured PDA activity will reveal the extent to which PDA use prompts and supports other learning.

5 Mobile devices and assessment of learning

This is emerging as an important area in the research.

Formative assessment

- Teachers are clearly concerned with the challenge of how to incorporate formative assessment with the use of mobile devices. This involves both verbal feedback based on in-lesson scans of pupils working and written feedback on work in progress.
- Regarding observing pupils working, the size of the screen is seen as a barrier.
- In the case of written feedback, traditional feedback via paper or exercise books is powerfully embedded and seen as flexible. Also, particularly in primary schools, it is thought that parents look for paper-based evidence of children's progress. The teachers involved in the research thought they did not have the digital equivalent of a pile of books.
- Where existing and emerging software solutions that address formative assessment are available, they could usefully be tested as part of the ongoing consideration of the most effective use of mobile devices to provide formative feedback.

Storage and access systems

- An increase in digitally produced work requires a consideration of protocols by which work is named, saved, stored, moved around, retrieved and made accessible. A range of solutions developed by schools – involving, for example, use of school networks made capable of receiving increased volumes of work, use of teachers' laptops, and the installation of an additional dedicated server – will be considered by the research in the coming months.

Supporting self-directed learning

- With 24/7 ownership of mobile devices, some pupils show evidence of increased independent and self-directed learning. Mobile devices are in some cases making teachers more aware of out-of-school learning. This presents teachers with a challenge. How do they track this learning to support pupils to move forward?

6 School-level issues

A range of management issues at school level are also identifiable in the early data. Many of these issues are not unique to the use of mobile devices, but rather relate to any major ICT initiative. These issues are relevant to headteachers and governors as well as lead agencies.

Dealing with issues

- Adverse conditions have been associated with technical problems, non-availability of key staff, non-availability of devices, and parental concerns or opposition.
- Even when a favourable context – in terms of school ethos, positive attitudes to technology, and embedding technology in teaching and learning – exists for the introduction of mobile devices, considerable resilience and appropriate strategies are required from all involved if enthusiasm is to be sustained when problems occur.

Provision of devices

- A number of associated, interlocking issues exist around the availability of mobile devices. These all have an impact on take-up and the development of effective learning.
 - There is evidence that pupils are more likely to remember to bring mobile devices to school and keep them charged if they feel they will be used. There may be a threshold of frequency of use that is important.
 - Classes in which not all pupils have useable mobile devices with them present teachers with problems. In some cases, this can be addressed by having a school stock of devices, but this is not always an option. Where this happens regularly, teachers need contingency plans and/or must improvise solutions that may not be ideal for learners. This is demotivating and time-consuming.
 - Key staff, such as classroom assistants and ICT co-ordinators, may not have mobile devices.
 - Work done on personally owned devices, rather than borrowed ones, appears to be valued more by learners.
 - If parents are unable or unwilling to make a financial contribution so that their child has 24-hour ownership, schools must decide what line to take on in-school use. This is not a new issue, nor is it specific to mobile devices. Schools and governors need policies and strategies to respond to this.
 - Parents and governors must be convinced of the value of the investment in mobile devices.

Relations with parents

- All schools put a great deal of effort into communicating with parents about introducing mobile devices and in recruiting them to provide financial support. However, there is evidence of opposition from a very small but significant number of parents. This has not destabilised either project, but it has caused difficulties for schools. The reasons for parental opposition need to be identified and understood. There is evidence emerging that when parental attitudes are positive and supportive, pupils use their mobile devices more often and more productively.
- Related to this is the issue of pupils' access to the internet outside school. Staff at the primary school feel responsible, as providers of the devices, to protect pupils and have tried to limit internet access to in-school time. However, some pupils have found ways to access the internet from home using the wireless feature of the PDA.
- More discussion with parents, agreements about contracts of responsible use, and explanations of the thinking behind them appear to be needed. This is particularly important when parents have different views from the school on what is and is not appropriate content for children, and when this content can be shared with the whole class in moments and taken by pupils into their homes by using their devices.

7 Technical issues

When introducing new technology such as mobile devices, from the outset the importance of the technical support structure is paramount.

Reliability

- New devices proved remarkably reliable, although in the secondary context the rough and tumble of daily use meant that devices were more prone to breakage.
- Minor technical problems with devices that had been used by other pupils were an issue. These needed to be dealt with to ensure that devices were available every day.

Connectivity

- Initially, connectivity to the wireless network and thus the internet was problematic in all schools. Problems ranged from uneven coverage of the school premises to a need to reset the network to make it compatible with the devices. When users needed to be connected for longer periods and in larger numbers (as opposed to low-level ad hoc browsing), available bandwidth became an issue. Solutions have been found in all locations, although in some cases this has taken time.

Breakages and insurance

- Breakages have been reported as being minimal in the primary sector. Very few children have been without a device for long. If devices have to be sent for repair, the turnaround time is typically no more than a week. The administration of insurance, repairs and replacements is not considered onerous. However, funding is not available for a set of spare devices, and classroom assistants do not have mobile devices.
- Breakages have been an issue in the secondary sector. A repair turnaround time of around three weeks has had an impact on the use of mobile devices. With large numbers being mended, it is difficult for schools to loan sufficient numbers of devices.
- Paying for breakages has also been a problem: schools have needed to charge for replacement screens. For the first breakage, a contribution towards the cost of replacement has been requested. For the second breakage, schools have asked for the full cost of the repair.
- The provision of hard cases has helped reduce the number of breakages. Evidence suggests that in the secondary phase, the mobile device needs to be very robust to survive in the bag of a highly mobile learner.

Complementary equipment

- Many activities, for example creating e-books, require the mobile devices to work in conjunction with a PC. To utilise the potential of mobile devices in learning, it is necessary to ensure that the required support and access to associated hardware – which may include networked PCs, the teacher's laptop and projector – is available.
- Flexible keyboards have also been offered to or acquired by some secondary pupils, which enable them to type more quickly.

8 Age- and phase-related issues

A number of general themes and issues emerging from the projects have been identified. However, it is important not to lose sight of the detail and variation also emerging in these projects. Not all learners or teachers respond to the devices in the same way, and these differences may or may not fall into distinct patterns. However, some clear differences are evident between the primary and secondary contexts, therefore these are discussed separately in later sections.

Emerging recommendations

At this early stage of evidence collection, themes are emerging which will be followed up in subsequent stages of the project. However, there are some general indications from the first stages of the implementation which suggest some useful recommendations. These broadly reflect the experiences across the settings involved in the research.

Implementation – policy

Mobile devices are best seen as an additional tool for learning.

The initial implementation of mobile projects is logistically challenging and requires careful planning and commitment from all partners. When this is in place, promising innovative practice is likely to ensue.

Even when a favourable context exists, all involved with mobile learning innovations need to be prepared for issues associated with, for example, technical problems, non-availability of key staff, parental concerns or opposition.

The open negotiation of contracts of acceptable and responsible use with both learners and parents/carers can be very useful in clarifying issues and areas of concern and in building mutual confidence and trust.

Teachers need to play an integral role in choosing software and content to ensure that it is relevant to their learners' needs. Where there is a good match to needs, teachers are more likely to make use of the devices.

When learners expect devices to be used, they are more likely to bring them to school every day and keep them charged. When all pupils in a class have their devices with them, the learning benefits are optimised. Especially in the secondary context, there needs to be a minimum frequency of use for pupils always to bring in charged devices.

Where possible, all relevant staff, especially teaching assistants and ICT co-ordinators, as well as teachers directly involved in teaching and learning, should be provided with mobile devices.

Implementation – technical

It is beneficial to ensure reliable wireless connectivity for the additional demands that will occur with the use of mobile devices.

It is useful to consider systems for dealing with breakages and temporary loss of use of devices. This may involve planning for temporary loan stock.

Systems for storage of and access to work need to be developed. When mobile devices are introduced, the amount of digital work will increase; teachers and learners need to access it to provide and receive feedback.

Consideration can usefully be given to possible software solutions to teachers' issues around observing process, tracking progress and formative assessment.

Professional development of teachers

Mobile devices are best seen as an additional tool for learning.

Teachers benefit from having time to explore what the devices can do before beginning to integrate their use in planned learning.

Peer support and mentoring build competence and confidence in teaching with mobile devices.

The use of mobile devices is likely to increase learner autonomy. This further increases the need to focus on ensuring that learners have appropriate levels of skills in evaluating resources, critical thinking and reflection.

Teachers should be prepared for shifts in the way they teach and pupils learn that follow from the introduction of mobile learning devices.

Teachers will benefit from support in dealing with issues around formative assessment and monitoring learning that arise in connection with mobile devices.

It is important to consider, in relation to learning, the ways in which mobile devices are integrated with other ICT tools (at home and at school) and with traditional tools.

Findings from the primary and secondary phase projects

This section reports in more detail on the baseline data collected from head teachers, teachers and students at the start of the project, on informal interviews and communications throughout the first six months of the project, and on classroom observations.

Primary phase

This section offers evidence of the experiences of one primary school. Additional schools have been recruited to the research project and this will enable future analyses to be grounded in a much larger data set.

The context

- The school was well placed to further develop the use of mobile devices. The concept of ICT as not separate, but embedded in teaching and learning across the curriculum, was well established, along with a strong orientation to developing this approach.
- In addition, the school had experience of mobile devices; the Year 6 class of 2005–06 had been involved in Learning2Go (L2G) Phase 2. That project was seen by the class teacher and headteacher as having positive impacts. Perceived benefits included: increased motivation among boys to read; increased evidence of school-related learning at home being brought to school and shared; increased self-esteem in children with special needs; more enthusiasm from some disaffected children about coming to school. Parents had also been enthusiastic.
- The headteacher, ICT co-ordinator and the two Year 5 teachers (one of whom had been the Year 6 teacher the previous year and who was the school's leading exponent of mobile devices) were looking forward to the children having and using mobile devices.
- The headteacher wanted to see the school continue to develop as a place where use of new technologies was firmly embedded in teaching and learning. She was committed to sustaining and increasing the use of mobile devices as standard tools for learning. She had a vision of classes as learning communities, with children actively contributing, collaborating and developing critical friendships. The school's investment in mobile devices was associated with driving up standards, engendering enthusiasm for learning and contributing to teachers' professional development. In particular, she hoped the research would provide firm evidence to demonstrate the impact that the mobile devices have on the children and their learning.

- The headteacher was aware of the pedagogic shift that mobile devices might support. She hoped that being involved in the research would enable the school to learn more about using the devices effectively.

The teachers

Year 5 teacher (with mobile device experience)

- The Year 5 teacher who was already experienced with mobile devices was a strong advocate for the technology. Her aspiration for the school was that in three or four years' time she'd like to see "fewer books, fewer exercise books". She wanted the mobile devices to enable interaction between the children and between classes; to encourage children to take much more responsibility for their learning.
- In the longer term, she had a vision of children "not necessarily... in the classroom any more". With widespread wireless networks, children could be anywhere, with teachers "bringing it all together". Learning would be "individualised... so it's the child that's the centre of it, as opposed to the whole class. It'll be the child with their own needs met."

Year 5 teacher (without mobile device experience)

- The second Year 5 teacher had no experience of mobile devices prior to the project. She felt excited about being involved. Any apprehension she felt was more to do with being able to resource teaching and learning with the new device than with the technical aspects. She welcomed the arrival in class of devices that would mean all children had a computer to hand at all times. Her experience was that children were highly motivated by technology, and she felt that having only restricted and timetabled access to the computer suite was frustrating and created barriers to embedding technology in teaching and learning.
- She was aware of the changes that mobile devices might make to teaching and learning in her classroom. In general she welcomed the potential shift in teacher–pupil relationships. She saw opportunities for more personalised and individualised learning and was aware that this would present her with challenges. In particular, she was concerned about tracking learning and incorporating formative assessment.
- Aspirations for herself were associated with her sense that more widespread use of mobile devices in education is inevitable. "It's actually not just a change within teaching... it's reflecting a change in society." She hoped involvement in the project would enable her to increase her range of strategies for teaching and learning and help her tailor her teaching in ways that would be beneficial to the children; in particular, to support those who "learned in different ways". She wanted to learn how to use mobile

devices most effectively, and saw the collaborative research as a supportive framework.

- Her aspirations for the children were increased choice in how to learn and increased engagement in learning. Associated with that, she felt the pupils would need to be helped to recognise when they were learning effectively and to develop a range of skills needed for more self-directed learning.

Teachers' use of time

- As with any new initiative, the mobile devices project placed demands on the teachers' and headteacher's time during the first six months of implementation.
- Because of a delay in the arrival of new devices, the school decided to use the mobile devices from the previous Year 6 project. The work to assemble enough devices was time-consuming, but the teachers were highly motivated to start on the project and were supported by the local authority team.
- The recycled devices were not completely reliable, and time was required to deal with minor repairs. The unavoidable long-term absence of the teacher most experienced with mobile devices meant that routine maintenance could not be shared.
- The Year 5 teacher who was new to mobile devices felt she needed to review resources available via the device in order to make the best selection for her teaching and the children's learning. This was time-consuming. She perceives this aspect of incorporating mobile devices as more demanding than the technical challenge.
- Pressure on teachers' time also had an adverse impact on effective communication with the support team visiting the school. When supporting staff visit schools to update content or software it is important that time is found to discuss and demonstrate upgrades to teachers. Where there is no opportunity to discuss, for example, additions to content or applications, this can reduce the teacher's sense of control over the mobile device as a learning tool.
- The headteacher engaged with a small group of parents who expressed some opposition to use of the mobile devices. Reasons for this opposition included: a dislike of having the technology at home, a belief that the mobile devices were not necessary for learning, and an adverse reaction to what some parents saw as a reduction in homework completed (and marked) in exercise books. In addition, there was an issue with material that was deemed to be inappropriate by some parents being shared among children. The L2G co-ordinator was very supportive and met families with the headteacher. Only one family withdrew a child from full participation in the project – the child did not take the mobile device home.

This presented the school with a dilemma because the child was provided with a device in school even though the parents did not contribute to the scheme. The wider issue of proving to parents and governors the value of the investment was also highlighted.

Professional development of teachers

- The L2G project has an inbuilt element of CPD for all teachers. Teachers new to the project are released from school to attend the training, and a support teacher visits the schools. Hands-on training is frequently one to one, and there is flexibility in that teachers can attend for a whole day or half a day.
- The Year 5 teacher who was new to mobile devices perceived the CPD as dedicated time. Before the start of the project, she attended two half-day sessions. She described these as opportunities to play with the devices and thought this was a good way to start.
- The training provided by the Wolverhampton L2G project was in addition to in-school mentoring by collaborating colleagues. The teacher who was involved in the Year 6 project (2005–06) was generally perceived to be the expert for mobile devices. She was also seconded to train others in the L2G project.
- Generally, professional development and training in ICT is the responsibility of the school's ICT co-ordinator. The ICT co-ordinator understood the financial constraints which meant that, because he is not a Year 5 teacher, he was not provided with a device. He regretted that he had not been able to be more involved in the development of mobile devices in the school.
- It was assumed that a large part of the professional development for the inexperienced Year 5 teacher would come from day-to-day working with her colleague as a mentor. This was seen as ideal and worked well until the unforeseen and prolonged absence of this teacher.
- After five months, the Year 5 teacher wanted to discuss with other teachers questions relating to management and assessment. In relation to content, both teachers thought that it important that they were not to given too much too soon. They needed time to consider how to get the best from content and applications.
- It is important to note that the particular circumstances in relation to the supply of devices and availability of in-school support mean that the CPD reported here is not characteristic of what was envisaged for teachers in the L2G project.

Impact in the classroom

- The baseline teacher interviews indicate that teachers were aware of ways in which mobile devices could bring about changes in how they teach and children learn. Teachers imagined a learning environment in which teachers were less controlling and the children's activity was more independent, exploratory and investigative. What children learned would be less predictable. The classroom would be more democratic with a different ethos.
- Although they welcomed such changes, teachers perceived challenges. These included ensuring that the devices were being properly used for appropriate purposes. More autonomous activity meant an even greater need to develop skills required by independent learners, including the ability to recognise when they were learning well.
- Tracking learning and giving formative feedback when mobile devices were used emerged as important issues because of the increased quantity of digital work being created.
- It was recognised that systems for saving, organising and accessing work were important. These were set up and children were trained to follow them.
- During an extended absence by one teacher, mobile device use declined, despite determined attempts by the other teacher and the pupils to support supply teachers who had no experience of mobile devices.
- However, there is plenty of evidence of mobile devices being used in a variety of ways. Experience of what works, gained from the Year 6 project, was drawn on extensively.
- The mobile devices were used in a similar way in different activities. For example, children made video/audio recordings in PE and literacy in order to review and evaluate performance; they took still images throughout sequences of work in design and technology and science to reconstruct the processes and to support recording, analysis and evaluation. This 'authentic' use has been positively received by learners. Animation is another application that is being confidently incorporated and used across the curriculum.
- Both teacher-directed and learner-initiated use of the internet or the school network to access or download information is a regular feature in lessons.
- Teachers and pupils work together on using the devices to manage learning.
- The children were responsible for ensuring that their mobile devices were charged. In general, they brought them every day in a usable state. The devices were usually out on the table alongside other equipment to be accessed as needed. There were no spare devices, so if any children

were without their mobile devices, teachers had to be able to adapt the plan or employ a management solution, which is usually not ideal for learner or teacher.

- Tasks, sheets for recording results, information about homework, and so on were downloaded or beamed around the room; this was seen as efficient and liked by teachers and learners.
- In terms of pedagogy, there was evidence of teacher-directed and teacher-set activity. Teachers reported examples of children using their mobile devices independently in and out of lessons.
- However, there are tensions for teachers between what they see as ideal uses for mobile devices and the current national assessment processes and demands. Attitudes of parents are also relevant here. The concerns expressed by parents about homework being set to be done on mobile devices (rather than in homework books) led to mobile-based work being required or suggested less often.
- The move from traditional methods to mobile alternatives, where these exist, can be a slow process requiring the development of an understanding of the full range of features of the mobile devices. For example teachers were concerned that they could not scan pupils' work on screen as easily as they could when the children were working on paper; accessing work to give written feedback was perceived as more complicated than marking exercise books. Teachers need to be aware of and encouraged to experiment with applications which relate to these concerns. For example, software which allows the handheld screens of all pupils in the class to be wirelessly synchronised with the teacher's laptop and made visible collectively or individually as appropriate; applications or systems which enable easy movement of work between teacher and learner. Without such awareness and professional development, teachers' use of mobile devices will be more limited.
- Issues around handwriting, use of handwriting-recognition software and keyboards are also being raised. One low-attaining boy liked using presentation software because "I don't have to do much writing." This is countered by evidence from another low-attaining boy who wrote more when using the keyboard on his mobile device. Increased choice for learners raises issues for teachers, particularly given the exclusively paper-based national curriculum assessment model, and the, currently, high-stakes nature of national assessment.

It will be interesting to see how these challenges and tensions are dealt with as the project proceeds and moves into Year 6.

The pupils

- The pupils in the sample are currently in Year 5. In the early stages of the study, information about the pupils' home backgrounds, attitudes to and use of new technologies was gathered through a baseline questionnaire. Other sources of baseline information were: data on pupils' attainment since the end of Key Stage 1; Tests to assess individuals' learning-related attributes of resilience, resourcefulness, reciprocity and reflectiveness; diaries of PDA use over one week; and observations of pupils in class, combined with unstructured interviews. The knowledge gained from these sources provides a context for analyses over the course of the project of patterns of PDA use and of attitudes to technology and learning, in and out of school. More specifically, it forms a basis for investigating the impact of the mobile devices on children's learning and attainment as they move into and through Year 6.

Background

- In general, the children in the sample come from technologically rich homes.
- All children have access to at least one computer at home. Almost all have home access to the internet; three-quarters via broadband and 42 per cent with wireless connectivity. Over a third have their own computer and/or digital camera; over half reported that they had a mobile phone.
- The children's attitudes to new technologies were generally positive, and their perceptions of the disadvantages of new technologies were invariably ideas commonly put forward in the media, for example that mobile phones cause brain damage or that the internet is a dangerous place.
- However, patterns of reported computer use at home were markedly varied. About half of the children defined themselves as frequent users. Others were more casual users. The out-of-school use of computers by three-quarters of the children was to have fun, and of the other quarter to do school work. Although most of the group said they visited websites at least sometimes, there was a wider divergence in those who used instant messaging: 34 per cent used it often and 44 per cent never.
- Similarly, the children reported a varied experience of using computers in school. Only playing games, downloading music and making websites were perceived as happening more at home than at school. Perceptions of the amount of in-school activity with still and moving images varied greatly within the group. The reported experiences of the two classes were also different in some respects, notably in that browsing the web for fun was mentioned much more in one class than the other.

- Overall, the questionnaire responses indicate that within the sample there were very different orientations to computer technology and different levels of commitment and enthusiasm; there is also some indication of a teacher effect on levels of use. There were no clear differences in attitudes and reported use that could be attributed to gender.

Pupils' use of mobile devices

- Observations of pupils indicate a sustained enthusiasm for mobile devices throughout the first six months of ownership.
- The week-long pupil diary, piloted in early December 2006, showed clearly observable differences in the amount, range and variety of use of the mobile devices out of school. Some children were already identifiable as high users, and some as low users, with the others falling along the scale in between. High users reported using the mobile devices for a variety of purposes on most days before and after school and at weekends. Low users did little with the devices except what was required to keep it charged.
- Games were clearly an attraction – in some cases, playing games was the dominant (or only) use recorded outside school. Uses of the devices in school, but out of class time, were also varied. The diaries of some children showed some degree of crossover between school and home (and vice versa) in use of the devices.
- The pupils' commitment to keeping the diary and the amount of detail recorded is obviously a factor to be considered. The research is exploring this. The diary activity will be repeated termly, and ways of increasing its effectiveness as an instrument are being developed with teachers.
- The patterns observable in the pupil diaries carry through into the classroom where some pupils were identified as class experts, although all children have a high level of competence with the devices.

Parental involvement

- Parents were consulted about the school's involvement in the project. Parents' evenings provided information, answered questions and recruited the parents into the financial contribution scheme.
- Parents were generally enthusiastic. Adverse responses from parents and the school's response to these are mentioned elsewhere in this report.
- There is some evidence emerging from interviews with learners that when parents are supportive and involved, children use their devices more often and more productively.

Overall

- In the primary school, despite the setbacks and emerging issues, there is still a high level of enthusiasm for and commitment to the project.
- The headteacher feels that there has been a stall in progress, but this is recoverable. Children bring charged devices to school with an expectation that they will be used in lessons or that they will interact around them informally with other children. It is clear from classroom observation that both teachers and children have advanced considerably in their technical understanding and capacity over the period.
- The attitudes and responses of parents are emerging as an important theme.
- As the project progresses, it will be possible to examine the interplay between a range of factors and the introduction of mobile devices in relation to children's learning. By combining all the data sources, it will be possible to construct rich case studies of individual learners to exemplify aspects of the research findings.

Secondary phase

The context

- The focus in the secondary school project centres on the science departments; therefore in each school three science teachers and two teachers from other disciplines were chosen for interview. The staff interviewed included a deputy headteacher (scientist) who is co-ordinating the project in one school, an assistant headteacher (chemist) who is co-ordinating the project in the other school, two biologists, a biochemist and a physicist. Other subject areas covered included design and technology, religious education (RE), ICT and English. The RE teacher is also a deputy headteacher with a remit for learning development.

The teachers

- When asked about their aspirations for the project, all the staff stated that they began with enthusiasm, despite the project's compulsory nature. The problems associated with technical difficulties, training and irregular use, have had a considerable effect on the enthusiasm of staff and have made them speculate about how to go forward.
- Without exception, the staff thought the project was rushed at its start. The majority thought they needed more time and support in terms of training and materials before the pupils received their mobile devices and, therefore, that the initial enthusiasm of pupils had not been constructively used in developing their learning. Lack of confidence in their own knowledge of aspects of the mobile device usage has also restricted many of the teachers and limited more adventurous ideas.
- An overall feeling of being rushed into what was viewed potentially as an interesting and exciting project may have been avoided if the schools as a whole had instigated a consultation period during which the staff's ideas and concerns could have been reviewed and skills development consolidated. In this way, staff ownership of the project may have sustained a more structured and progressive approach.
- Despite the considerable initial problems in the first term, there was renewed progress in the second term. New ideas and the development of carefully thought through activities have formed the basis of some developing aspirations offering the possibility of effective use that could ultimately support more effective learning. The ideas that are beginning to emerge are frequently quite small scale, but based on the confidence of the teachers to use the mobile devices effectively and therefore having firm grounding. The developing ideas appear to be supported constructively by the project technician, enabling the development of their sustainability.

Teachers' use of time

- When there has been regular use of the mobile devices in lessons, such as in the case of the RE teacher and two of the science teachers, there is a feeling that the mobile technology is beginning to pay off in cutting preparation time and that further developments will lead to further effective use of time.
- In other interviews, teachers who have yet to develop sustainable activities suggest that the process of planning is time-consuming and that it is not a first priority when considering the pupils' education. However, most were willing to admit that they thought they should give time to developing activities with the mobile device to aid learning, particularly among the underachievers.

Professional development of teachers

- The Hand-e Learning project was introduced to teachers in July 2006. The training event for Year 10 staff lasted six hours, and the staff received their mobile devices at that time. Science staff received extra training as a twilight session in June 2006. Other twilight sessions have taken place for training and for meeting as a group for discussion and development of materials.
- Another source of support was the [CLC3 Hand-e Learning project website](http://www.bristolclcs.org.uk/?_id=360) [http://www.bristolclcs.org.uk/?_id=360], which offers help for teachers. This includes support in the form of help with mobile devices, information about free downloads, and a teacher area that offers forums about technical issues and handhelds.
- On the whole, the staff interviewed have not found the training that they received initially to be as effective as they hoped. Some thought they needed more basic training on how to use the devices, and there was a desire for more hands-on experience in smaller groups. The majority of staff interviewed thought they needed some clear examples of how to use the mobile devices constructively in a formal learning situation. Most of the science teachers thought they would be provided with a bank of materials and schemes of work that they could use to enhance their teaching strategies using mobile technology.
- Co-operation between the two schools and the city learning centre (CLC3) to support the development of materials and sharing of good practice has been instigated. One school has included tips for use of mobile devices as part of the school's teaching and learning briefing, which lasts for ten minutes one morning a week.

- A deputy headteacher (RE teacher) in charge of learning commented in his interview on the various stages that teachers have reached with skills in using their mobile devices. He thought that the initial training had been a positive experience because it showed the device's potential. However, he thought also that not all teachers had taken the next step and made the device a tool for daily use. Individuals' confidence played a large part in how much they used the mobile device. Many had reached a point of using it as a personal organiser, and some staff had gained confidence to use it in lessons. He thought it was important that they tried out little things that could be successful, and that each teacher moved at his or her own pace.

Impact in the classroom

- As would be expected in the secondary project, the wide range of teachers, learners and contexts created enormous variation in models of use.
- One factor that affected in-class use was the number of learners who had their mobile devices with them in the lesson. This number can vary enormously. In an observed double science lesson, all but four pupils had their mobile devices. Reasons for not having mobile devices included one not working and two not being charged. In a second lesson on the same day, in a group of 12, only four pupils had devices. The main reason given for not bringing devices to school in this case was that the devices were not always used. In this lesson the teacher had a loan stock available and could give devices to all for use in the lesson. Where devices were loaned in this way students exhibited little evidence of any sense of ownership or of personal control over the device. Students who had brought their own devices used them effectively. They also said that they (small number who used their own devices) had used their devices at home to support their homework and for entertainment.
- There is some evidence emerging of pupils who are enthusiastic and knowledgeable users; for example two boys were used as experts to help others including the teacher in a science lesson. These pupils also seemed to make more spontaneous use of the devices to support their own learning and could not understand why others did not also.
- Using the device to capture work that might otherwise have to be recorded manually is an emerging practice. Examples include giving pupils a copy of the slide presentation of the lesson so that they could refer back to it at home if needed or work from it on their mobile devices in the lesson rather than from the board. During a science practical demonstration, the pupils can be offered the opportunity to visually record important parts of the process on their devices, but this is not always taken up unless stated as a

requirement. On one observed occasion, only four of the pupils actually did this. Using photographs rather than drawing to record the equipment they have used is also emerging as a practice. Animation has been used by pupils as a novel way of representing their work. However, since wireless internet access has improved, internet searching is now the most common use of the mobile devices, both formally and informally.

- Overall, the pupils' response to lessons appears to be enhanced by the use of the mobile devices. When content was available to them on the device as well as on the screen at the front of the class, pupils thought they were able to concentrate on their work without always referring to the whiteboard. They said they appreciated the fact they had the core information available after the lesson and so were able to participate in other activities rather than make notes. Using the camera, spreadsheets and note-making applications to record experiments in science also appeared to be helpful. At no time did it appear that the mobile devices had a negative impact, and they appeared to aid the autonomy of the top-set, self-motivated, triple-science pupils.
- Several learners interviewed thought it was good not to waste time writing down material from the board so they could get straight into the research aspect and answering the questions. A left-handed boy felt he was less disadvantaged using the mobile device and wondered why those with poor handwriting did not use it more. Most said they found the animation software easy to use. One boy preferred books. It was evident that many of the less-able pupils were not confident using the mobile devices. It appeared that this was because they had not used their mobile devices enough and found the process fraught and embarrassing. At least one pupil did little work in an observed lesson, but spent the time playing on the mobile device, while another used the stylus to make holes in an eraser. It must, however, be stressed some of these pupils had learning difficulties involving concentration.
- Despite the above, all the pupils wanted to use the mobile devices more. They said they preferred to access the internet for information rather than to use a book, and they liked using the devices for planning, listening to music and taking pictures. They found the devices easy to use and not too small to read. Two boys who were worried about presentation wanted to use the device more for writing. Another boy stated that he would like to use the device more often to look at websites, type, beam work and stories around, and instead of reading a book. However, many also claimed that they no longer brought their devices to school because they never used them.
- Discussion with pupils revealed that features that were appreciated included the transcribing function, the calendar and the SD card for storage. One boy wrote his essays on the device, used a spreadsheet to

record his timetable, liked to theme the device's appearance and thought that others would enjoy using it if they knew more about how it worked. He had not used the animation software very much and initially had problems getting onto the internet. He wanted to be able to lock the device so that it did not come on in his pocket and run down the battery.

The pupils

Background

- The baseline survey, which took the form of a questionnaire, provided indications of how ICT is used by the pupils at school and at home.
- Nearly three-quarters of the pupils had a parent who used computers at work, and the availability of technology at home was very high, with over 90 per cent having a television, computer, internet access, games console and digital camera. Many pupils own their own equipment; the most noticeable gender difference was the much higher frequency of boys owning games consoles: over 90 per cent of boys own their own games consoles compared with 60 per cent of girls.
- Most of the pupils played electronic games in school and at home, with more boys playing them than girls and doing so considerably more frequently. Boys participated more than girls did in film/animation activities in school and at home. However, the girls were far greater users than boys of photos and pictures at home, although school use was low for both. Half the pupils, regardless of gender, downloaded music in school, a figure that rose to about three-quarters of pupils outside school. Girls used ICT for writing only slightly more than boys did, while boys used charts and tables slightly more than girls did in school. The students' reported use of computers at home showed similar gender-based patterns. However, overall, computer use was less frequent at home than at school. All the pupils used the internet for finding information at school, but more boys than girls browsed the internet for fun. At home, about 80 per cent of both sexes browsed the internet frequently. More girls than boys sent emails at school and at home, but only slightly more girls (80 per cent) than boys used MSN messenger at home. When asked what they did when they had a problem on the computer, boys show a greater tendency to try for longer and look on the internet for support, while girls were more prepared to ask for help.
- This baseline survey information will be used when considering the developing attitudes and use related to mobile technology. The gender differences need to be taken into consideration, especially in the light of the concern over boys' academic performance.

Parental involvement

- The parents' evenings that launched the Hand-e Learning project were well attended, indicating great initial support. The deputy headteacher in charge of the project in one school thought that parents were quite happy and that those with wireless connections at home thought that using the mobile device freed the PC for other members of the family. He stated that he had no complaints from home.
- However, evidence from discussions with pupils and teachers suggests there is a feeling that so far the project has not come up to expectations and continues to cost money.
- On the positive side, one science teacher said he thought that pupils did sometimes show their parents the experiments they had filmed in class. More use in lessons and for homework would probably lead to a natural increase in parental involvement. At this stage there appears to be little parental engagement, based on information gathered. The role of parents will be an element of the next phase of the research.

Overall

- In secondary schools, technical issues have been a major part of the initial problems of the project, which have led to pupil disillusionment and teachers' lack of participation. In addition, the training of teachers has not been as generally effective in supporting classroom use of the PDAs as had been hoped.
- As technical issues are resolved and ways found to accommodate inherent features and applications of the devices that were not fully appreciated at first, a new understanding and a desire to try again within a controllable framework are emerging. Offering good readily available technical backup combined with training and, in one case, a re-launch, appears to have made a positive impact. Thinking is ongoing about how best to involve and continue to support teachers who are emerging as leaders in the incorporation of mobile devices in teaching and learning.