Technologies involving parents and guardians with their children's learning

D. Passey

Department of Educational Research, Lancaster University, Lancaster, LA1 4YD, United Kingdom

This chapter will consider impacts of affordances of technologies on parental and guardian engagement with their children's learning. Past evidence about effects of different practices will be reviewed. More recent findings from national and regional-level research undertaken in this field in England will be discussed in more detail. Although the chapter will focus on research studies completed in England initially, it also draws on insights into practices in some other countries, (where parents have been involved in education in a range of ways). Discussions about different national contexts will be used to highlight social, cultural and technological approaches and implications.

Keywords home learning; parental involvement; technologies and home learning; impacts of parental support

1. Introduction

Technologies enable a widening range of learning activities to be increasingly accessible in homes and other out-of-school locations (such as libraries, museums and youth centres), as well as in schools themselves. Children's work in school can often now be accessed by the children themselves and by their parents, enabling work items to be edited or amended (and indeed initiated or completed too) in homes or in other locations. This wider accessibility for children, through the Internet and through virtual learning environments (provided in different localities in a variety of forms), means that children's school or educational work is much more visible to parents, guardians and others in home or out-of-school locations. Is this enhanced access and visibility of benefit to children, or to parents and guardians, or to both? If it is, are there practices that will support those benefits for children and for their parents and guardians?

Parental contributions to their children's learning have been recognised and measured in a number of past research studies. As Bransford, Brown and Cocking [1] stated (p.153) in their review of school-based learning and effective learning practices in the United States (US): "Learner-centered environments attempt to help students make connections between their previous knowledge and their current academic tasks. Parents are especially good at helping their children make connections." The authors were pointing to the fact that parents and guardians are not only in a position to support their children, but may also have insights and personal knowledge about their children to enable learning connections to be made. Desforges and Abouchaar [2], from their review of research findings about the influences of parents and guardians on children's achievement, stated (p.4) that: "parental involvement in the form of 'at-home good parenting' has a significant positive effect on children's achievement." They concluded that: "In the primary age range the impact caused by different levels of parental involvement is much bigger than differences associated with variations in the quality of schools" (pp.4-5). In a later review of the research on this topic, Harris and Goodall stated, in a report to the then government department for education (DfES) [3] (p.5), that: "Parental engagement is a powerful lever for raising achievement in schools. Where parents and teachers work together to improve learning, the gains in achievement are significant. Parents have the greatest influence on the achievement of young people through supporting their learning in the home rather than supporting activities in the school. It is their support of learning within the home environment that makes the maximum difference to achievement. Many schools involve parents in school-based or school related activities. This constitutes parental involvement rather than parental engagement. Parental involvement can encompass a whole range of activities with or within the school. Where these activities are not directly connected to learning they have little impact on pupil achievement." These authors pointed to the need for the forms of interactions between parents and children's learning to be direct if impact is to arise.

The involvement of parents in encouraging, noticing and supporting learning activities alongside or with or by their children is clearly a key factor that research studies and reports identify as important if outcomes are to be enhanced. Clearly, a heightened visibility of children's learning materials has the potential to enable wider engagement. The influences that can both bring about educational engagement of children and affect their resultant outcomes, however, go beyond merely having access to technologies, or selecting resources, or using resources that are designed in particular ways, or depending on teachers choosing pedagogies to match learning approaches (discussed in McFarlane [4]). Some key influences that bring about wider engagement and enhanced outcomes are much more socially driven – for example, involvement with parents (parents encourage children by taking note of their work and positively praising them), contextual experiences of children (being in environments where children's work is seen to be valued and where they are asked questions about it), or discussion with peers (other children taking interest in their work and taking pleasure in their findings), discussed in government policy documents in England (by the independent inspection service Ofsted [5], and by the government education department DfES [6]). In terms of supporting engagement that is

educationally effective, parents and others are interacting socially, while the technologies are supporting these social drivers through affordances that link and enhance these interactions (which are here termed social affordances). In the United Kingdom (UK), the potential for technologies to enhance socially home-based influences has been highlighted by research over a number of years. Some early studies explored facets of this potential, undertaken at a time when the Internet and networking infrastructure linking homes and schools were first being explored, and subsequently using mobile technologies that could allow work to travel on mobile technologies (laptops and palmtops) between schools and homes (described in Passey *et al.* [7, 8]; Kirkwood [9]; Passey [10, 11, 12]). Since that time (around the year 2000), the role of technologies in enabling increasingly stronger social engagement and interactions between children, parents and teachers, through features building more positive inter-relationships, have continued to be exploited and have been a focus of a number of research and development activities that have taken forward those early pilots. The British Educational Communications and Technology Agency (Becta) was involved for some 2 years prior to 2010 in undertaking a national UK project that focused on the ways that technologies could support increased parental involvement with education and engagement in their children's learning (Becta [13]). At the end of this project, it was clear from responses and practices of schools involved when reporting in a national conference, that although they were at early stages in development terms, they reported outcomes indicating that this was clearly an area they felt (primary, special and secondary schools) was worthy of further development and research study.

2. Findings from past studies

Studies in the UK that have looked at educational influences and impacts of technologically-based resources in the widest senses have often looked at school-based influences on learning and have measured impact through broad national test measures, assessing learning across the widest range of topics in a subject area (for example, Harrison *et al*. [14]). Other later studies, since 2002, have explored more the wider social influences involved when technologies are accessed and used increasingly within home settings, but have measured impact in similar ways (Lewin [15]; Valentine, Marsh and Pattie [16]; Underwood *et al*. [17], for example). Other studies have sought to disentangle impacts of social influence involved over a period of time from other influences such as technologically driven resources (in the longitudinal study of Chowdry, Crawford and Goodman [18]).

Another influencing factor highlighted by early studies around 2000 was the issue of limited access to technologies in homes. As Kirkwood [9] stated (p.257): "Learning is increasingly being mediated through a range of technologies and where home-based learning is undertaken using domestic equipment and facilities, there is a need for course designers to consider the complex and varied realities of the study environments. Access to ICT [information and communications technology] is far from ubiquitous, even in affluent developed countries." Lewin [15] commented that where access did arise, this was often found to be beneficial (p.151): "Use of ICT in the home to support school-related work is limited but valued by pupils, particularly the opportunities to use superior technology and engage in activities for extended periods of time" but that where this did happen "Pupils are using networked technologies to define their own learning curriculum (albeit often unknowingly), acquiring knowledge and developing their social skills as well as competence and confidence in the use of technologies."

By 2007, Somekh *et al.* [19] reported a much more favourable picture about technological access in their study that explored an ICT test-bed initiative, stating that (p.7): "The majority of students in ICT Test Bed schools, as in other schools, now have access to computers at home." They went on to say that: "ICT made it much easier to share assessment information with parents via school websites or learning platforms", and that "Schools slowly increased their use of email – and, in some cases, text messages – to communicate with parents, enabling them to respond to parental enquiries more rapidly. However, establishing a two-way dialogue with parents was more challenging." While technological access was not identified in this case as an issue, establishing appropriate forms of social interactions that would enable parents to support their children's learning was identified as more of an issue. Plowman, McPake and Stephen [20], in their two-year empirical investigation of three- and four-year-old children's uses of technology at home, based on a survey of 346 families and 24 case studies, identified affordances that were supporting children's interactions and engagement with the outside world. They found that (p.308): "children had learnt to switch items off and on, rewind, fast-forward and navigate websites. In terms of extending knowledge of the world, children were using technology to support the development of early literacy and numeracy or information gathering. Dispositions to learn were enhanced through the opportunities for developing independence, sustaining attention, building confidence gained from accomplishment and learning to follow instructions." They also found that parents were providing an important learning context, saying that (p.315): "Parents and other adults, as well as children, were demonstrating all three areas of learning we identified in pre-school settings (operational, by acquiring technical skills; extending knowledge of the world, by finding and developing information; dispositions to learn, by finding pleasure in these activities and, sometimes, learning the need for persistence) as well as learning about the cultural roles of technology. So, although parents tended to recognise only operational learning, they were providing many opportunities for learning to take place."

In terms of measuring the impact of home-based engagement on children's learning, Somekh *et al.* [19], in a study exploring differences in national test results for 28 schools supported with high levels of ICT over a 4-year period

compared to a comparison group and to national test averages, reporting about these schools initially, stated (p.8) that: "At the start of the Test Bed project in 2002, the Test Bed primary schools were performing less well than matched comparator schools on a range of key performance measures: Key Stage 2 [age 7 to 11 years] English, mathematics, science and the APS [average points score] per institution. They were also underperforming compared to the national average on all of the four measures, with English and mathematics being of particular concern." By the end of the project, it was reported that the shift over the 4-year period from 2002 to 2006 was, for mathematics, 64% to 75% compared to 74% to 73% for the comparator schools. It should be noted, however, that shifts were not identified at Key Stages 1 (age 5 to 7 years) or 3 (age 11 to 14 years), and that at Key Stage 4 (age 14 to 16 years) the only indicator where there was comparative shift was the percentage of 5 A*-C grades (highest grades of the national examinations) at GCSE (39% for Test Bed and 36% for comparator schools). Their results indicated that high levels of technologies enabling learning activities to be undertaken in schools and in homes was leading to statistically significant results at Key Stage 2 only (for pupils aged 7 to 11 years).

Watson and Watson [21] (p.52), in 2011, reported that technologically-based resources can afford choice and self-pacing for learners: "Both teachers and students expressed how important technology was to them, as it provided endless resources for learning in this marginalized and disadvantaged alternative school's situation of extremely limited resources. CBI [computer-based instruction] technology was important in this learner-centered culture, playing the role of an instructional choice that provided students with self-paced learning for math and science." This finding indicates that resources can provide opportunities for children to work in locations that are remote from classrooms and schools. Technological access and resource selection can therefore allow learning activities to take place in homes; the development of social interactions to support those activities is clearly another contributory aspect that needs to be explored further. Indeed, the need to continue to focus on identifying and supporting underlying ways of engaging parents with children's learning are raised as matters for concern in a range of studies. Cullen, Cullen, Band, Davis and Lindsay [22], in a study that explored Parent Support Advisor (PSA) pilots in 15 local authorities (LAs) in England showed little early planning for, and limited involvement with, fathers in support of their children's learning and learning engagement in homes. Kiernan and Mensah [23] looked at 5,462 children assessed at age 5 years, with mothers interviewed at periodic intervals. They found that (pp.327-328): "half the effect of poverty on children's achievement may be explained by parenting and around 40% of the effect of family resources may be explained by parenting," going further to say that "children from poor families and those with lower levels of family resources who experienced more positive parenting were more likely to do well in school." Skaliotis [24] looked at data accessible from the longitudinal study of young people in England (LSYPE), investigating 15,770 young people aged 13 to 14 years for a 2 year period until they were 15 or 16 years of age. They stated in conclusion that (p.993): "The analysis gives a clear indication that the attitudes and behaviour of the young person are associated with changes in involvement for both parents. In particular, the young person's attitude, behaviour and relationship with the mother were associated with change in maternal involvement and the young person's behaviour was strongly associated with change in paternal involvement." Using technologies to support engagement with children's learning needs, therefore, to accommodate effective practices of parent and guardian engagement as well as offering practices concerned with aspects of appropriate learning support.

3. Findings from recent UK studies

It is clear from existing research evidence that enhancing parental engagement in learning practices, so that children are able to gain from their parents' interests and so that they are able to use role models of their parents' practices, can enable children to more positively develop their own longer-term practices focusing on educational involvement. But, as Byron pointed out in her report to the government education department [25], there is an important need to consider the developing social needs and shifting social relationships of young people over time, if roles of both parents and technologies are to be understood and accommodated within an appropriate framework of developing practice (also highlighted by Plowman, McPake and Stephen [20]). How technologies support parental engagement and interactions for home learning contexts of 5 year old children and of 12 year old children clearly need to accommodate different stages of social development and social relationships between parents, guardians and children. This section will look at findings from studies that have focused on children aged 5 to 11 years. These studies have explored how contributions to the parental engagement arena have been afforded through access to and uses of integrated technologies involving learning platforms in one local authority (LA) in the UK (Passey [26]), and forms of activities that have supported parental engagement and intergenerational learning in another LA (Passey [27]).

In a study of learning platforms introduced into primary schools across one LA in the UK, Passey [28] found that different approaches to engaging parents and guardians with their children were being employed in different schools. As an example, in one primary school, they were developing video demonstrations of specific learning skills. A video produced by pupils for parents was on the topic of 'chunking', a technique used in mathematics lessons, but unlikely to be known by parents. The video was produced by pupils with teacher support, using pupil voices, which was found to engage the parents. While the pupils felt that the main purpose of this activity had been to widen awareness of lesson activities for their parents, there were two other reasons why the school wanted to develop these forms of practice: it

enabled the pupils to demonstrate and reinforce their learning; and it developed aspects of learning with the parents (as they might well discuss the content of these videos with their children when they saw them).

It is clear that different technologies (such as learning platforms, online resources, or mobile devices) can offer different affordances that support social engagement between parents and children (social affordances). Across the 23 primary and special schools involved in this study (Passey, [28]), the different approaches to engagement that were taken, and the different forms of social affordances involved were:

- Communication-based affordances:
  - Pupils were involved in regular weekly communication from school to parents.
  - Texts to parents were used to alert them to announcements, news and homework activities.
  - Resources about topics and homework were made available to pupils and parents in advance of them happening in lessons.
  - Homework activities and reminders that activities needed to be completed by certain dates were put into pupil areas of the learning platform, which could also be seen when pupils logged on at home.
- Video creation-based affordances:
  - Video clips recorded in school about events and learning activities in classroom were madeccessible to pupils and parents at home.
  - Podcasts and videos of school events and classrooms activities were created by pupils and shared with parents at home.
  - Pupils created a video for their parents about how they learned a specific subject topic, as this was likely to be different from the way they were taught when they were at school.
  - Pupils created videos of events that happened in school that they shared with their parents.
- Audio recording and presentation-based affordances:
  - Nursery aged children (3 to 4 years) recorded verbal messages through a microphone, retained as audio files, and replayed via an interactive whiteboard to parents during a school-based event.
- Online resource interaction-based affordances:
  - Pupils accessed and showed parents at home how to use an online set of learning resources, such as *Mathletics.*
  - Pupils in special schools were given access to resources and homework activities, involving oversight from their parents or guardians.
- Online homework-based affordances:
  - Homework was accessed, completed and submitted online by pupils at home, with possible oversight from parents or guardians.
- Online discussion-based affordances:
  - Teachers set up online lessons and discussions when the school was closed, so that pupils could become involved, and their parents and guardians could oversee their activities at home.
  - A discussion about a subject topic was set up, which could continue for many months, with parents at home having oversight, and also discussing points with pupils.

This list of different forms of learning activities involving parents shows that there are distinctly different ways in which parents interact socially with their children, from more passive involvement (although interest and encouragement are still clearly potentially important features of those interactions) through to more active involvement (where parents look at and discuss work with their children). Overall, as Passey [28] concludes (p.28): "Learning by modelling is a very important feature for many learners; we base our output on experiences and assessments of what we have previously modelled as 'good' or 'effective' or 'useful' (and this can include our modelling of learning behaviour as well as learning artefacts). It is important that we are each able to model exemplary practice for ourselves; we cannot necessarily all construct exemplary practices from examples that are just shown to us or related to us by others. The learning platform is clearly allowing a range of learners to actively model and construct learning behaviours and outputs (although it is not always clear yet how many learners are, or could be, involved in any area of activity or task). Those learners who are modelling their behaviours about completing homework, those who are modelling their behaviours about discussing points of information or opinions with others, those who are modelling their ideas of how to create a text or video through successive editing to engage a wider audience, those who are modelling their behaviours and practices in order to enable their activities to be accessible to their parents, those who are modelling their verbal output so that it is clear and distinct when heard by others, are all gaining through the use of the learning platform in important ways. If these forms of modelling can be identified, and then taken further by teachers so that these practices can be extended or deepened or both, and possibly taken forward in other areas of practice, then additional important longer-term learning outcomes will, of course, be possible." Social affordances provided by examples of practice, explanations, online resources that engage discussion, or online completion of activities that enable comment, all support different aspects of parental engagement with their children. However, it is also clear that many parents feel they are not in a position to support their children, because of lack of understanding, not only of the content being covered, but also of the practices involved in effective support. In the article on ways that learning platforms are supporting parental engagement with children's learning, Passey [28] says (p.28): "From the point of view of parental involvement with

learning, the learning platform is providing important elements – both artefacts and scaffolding. Resources that teachers make available, such as songs that parents of nursery age children can download, allow parents to access these artefacts for learning. Teachers provide additionally the details required by parents of what to do with these artefacts, what feedback they could provide to the teacher, and the means for the parent to give that feedback to the teacher in timely fashion (scaffolding). The learning platform has the potential to provide such an architecture for learning, allowing pupils, teachers and parents to all be involved in appropriate forms of awareness, encouragement and support. Whilst forms of practice that are involved in using this architecture are at early stages, it is clear that this opens up a wider research agenda for deeper and longer-term study."

A study in the UK, examining the ways that parents and their children gained access to online technologies at home, which were linked to resources provided by schools, provides further evidence of how social affordances can be employed, and how artefacts and scaffolding can be put in place, in this case in situations where families live in an area of low socio-economic advantage (Passey, [27]). This study examined one of a wide range of projects run nationally that were designed to support the long-term development of socially deprived communities. The final evaluation report of the national New Deals for Communities (NDC) initiative (Batty *et al.* [29]) detailed outcomes for all projects that were run across the country. The report stated (p.6) that: "There has been considerable positive change in the 39 NDC areas: in many respects these neighbourhoods have been transformed in the last 10 years." The report went on to say (p.8), however, that: "education has been one outcome where, not only has it been difficult for NDC partnerships to make an impact, but there are also, albeit weak, negative associations between higher rates of spend and change in general." This was not the case in the area studied by Passey [27], however. A strong educational lead was taken at an early stage of this local project, schools adopted change including technological change, and implemented a model where parents were involved in using technologies to support and engage with learning activities with their children, while the children supported their parents in technical operations, through an intergenerational model of development.

The initiative involved an Information and Communication Technologies (ICT) project, which was one element within a wider educational support and change theme. This theme focused on the implementation of five areas of support and activity – arts and performance; extended learning; physical and experiential; technological including ICT; and environmental and residential visits. At the outset of the initiative, school performance was measured through end of Key Stage 2 (when pupils were 11 years of age) SATs (national Standard Assessment Task test) results, and indicators of serious weaknesses of school performance from the national independent inspection service (Ofsted). At the outset, those indicators of performance were generally low when compared to the same performance indicators in other similar schools in the city and nationally.

Different forms of evidence were gathered and used for the evaluation of this initiative. Evidence about prior forms of ICT in homes and levels of uses by family members were gathered from all 812 home installations (all those involved in the third phase of the project), from 154 family members following the installation of computers and Internet access in the homes and their experiences of the installation and the process of reporting faults or issues subsequently arising (randomly identified), and from Year 3 and 4 pupils (aged 7 to 9 years) in 7 schools using pre- and post-test data indicating mathematics and reading levels. Additionally, data about courses attended by parents and their levels of ICT reported by trainers, responses from 32 teachers to online questionnaires about their support for the initiative and from 85 teachers about their uses of technologies in schools and how they were supporting uses in homes by pupils, responses from 134 pupils to an online questionnaire that indicated their experiences with the technologies and how they were using them, and responses from 20 parents to online questionnaires about their different forms of uses of the technologies at home, and from 20 semi-structured interviews about their experiences and the ways that the technologies were supporting their children and their engagement in learning activities with their children were also gathered. The evidence was used to complete elements of a picture that built detailed elements of a case study, in the way described by Yin [30].

The technological backbone for the initiative was a wireless infrastructure. Reports from schools and parents indicated that this was robust, that it offered good coverage, and provided for high bandwidth in general (with only a very few localities reporting issues at certain times), but it took quite some time to reach this point, so that uses of online resources that depended on high bandwidth could only be tested within the last year of the initiative. The installation of equipment into homes was phased over a period of years. By January 2007, data gathered during that phase of the project (from Year 3 pupils aged 7 years in two primary schools where the pilot had been integrated to the greatest extent), indicated that 125 computers successfully installed into homes were being used by 56 mothers (in some cases supporting English language access and practise) and 88 fathers (in some cases supporting work needs). Significantly, 945 people in total were using the computers (a leverage factor of 7.6 people per computer, and supporting some 6.6% of the total official 2005 local population through access from only 5 classes of Year 3 pupils).

From the outset of the 4-year project, intergenerational learning had been a key approach embedded within the implementation practices. Pupils were trained in using ICT in schools, family members were able to attend training sessions in schools, and teachers provided learning activities that would allow parents to be involved at home in working with or alongside their children. Using technologies for learning was a key focus of the initiative. It was known at early stages from interviews with parents and community members that many families were supportive of enhancing education for their children rather than taking on educational courses for themselves.

This initiative enabled the parents to provide computers to support their children and their children's learning, and additionally, a range of parents gained interest in using the facilities for their own (employment, training, and leisure) purposes. Software available through the initiative was placed on a learning platform, accessible in homes as well as in schools, which enabled teachers to provide activities that involved, in a range of cases, research-based work, as well as more specific activities, such as those focusing on mathematics using *Mathletics* and *Education City* software. The focus through the project on parental training and involvement was highlighted by evidence from parents and pupils as being particularly important. Training programmes for parents, to raise their skills in using the ICT accessible within their homes, were routinely run in 9 schools for two years from March 2009 to March 2011. At least 1,227 parents and family members were involved in training, many in earlier sessions having children in Year 3 (7 years of age), but with high numbers also in Years 4 (8 years of age) and 6 (10 years of age), but with representation from across the entire age range from Years R to 11 (4 to 16 years of age). Most parents trained were of an Indian sub-continent ethnic background, mostly of Pakistani or Bangladeshi ethnic origin. Reported data suggested that numbers of family members involved in ICT training were increasing as the project became more mature, and that levels of ICT skills across the locality were increasing (earlier reports suggesting that many more beginner level outcomes were identified by proportion). From November 2010, schools offered one-off 'INSPIRE' workshop sessions, that focused on parents working with their children using online resources that teachers would set for homework activities.

Most evidence about outcomes of the project was gathered from pupils, parents and teachers in December 2010. From pupil feedback (134 pupils across 5 schools and across Years 4 to 6), the vast majority indicated that they had enjoyed using the computer at home, most (109 in total) used it most days or every day, many (79 in total) used it for an hour or more at a time, and most pupils (96 in total) clearly relied upon the computer for their school work at home, and were encouraged to use it by their teachers. Most of this home learning use was focused in the subject areas of English and mathematics, but there was also a clear shift in terms of activities requiring them to research and to write more at home.

Teachers providing evidence at the same time (85 teachers in total from across six schools, teaching across Years R to 11), indicated that they felt the initiative had been useful (in 76 cases), but, importantly, many teachers felt that pupils' home access to computers had supported a change in their own (teachers') practices. The largest change that was reported was in using online facilities to provide homework activities. Clearly this had shifted the types of homework activity that pupils could be engaged in, and it was clear that some teachers were then asking pupils to undertake tasks such as research, which were not demanded of them previously. The practices that were involved heralded a shift in terms of what was demanded of pupils outside classrooms, and it could be that these practices were in themselves changing the qualities of learning demands outside the classroom. It appeared that more was being asked of pupils by some teachers as a consequence of the shift in what pupils could access, manipulate and use at home.

In terms of teacher contact with parents, a key point raised by teachers was that visibility (of school intentions and classroom practices) had increased - children's work was more visible to parents, school intentions were more visible, and the means to discuss points and issues were more visible. Some teachers noted shifts in terms of questions about homework being raised by parents, and questions about amounts of homework being set. Responses from teachers indicated that they felt that parents had gained higher levels of awareness about what their children did - in the region of a 72% shift in terms of level of awareness (measured by numbers of teachers indicating that they felt that this was the case). Importantly, responses also indicated a shift in the region of 61% in terms of level of engagement of parents with their children's learning (again, measured by numbers of teachers indicating that they felt that this was the case).

Overall, parents reported that they particularly valued the support gained for their children, the reasonable cost of the computer package, and the technological affordances providing them with support for employment and training purposes. They identified very few issues, and where these issues related to Internet access, they had largely been addressed quite quickly once the major wireless infrastructure was in place. Parents highlighted particularly the benefits associated with homework for children, with being able to be engaged and being able to monitor what their children were doing in their learning (also in the context of use of online programs such as *Mathletics* and *Education City*).

Although the quantitative element of this study did not deploy a randomised control test model, benchmarking test data (in March 2010) and final test data (in December 2010) from Year 3 and 4 pupils (initially 7 to 9 years of age in March 2010) who had moved to be in Years 4 and 5 (8 to 10 years of age at the end of the test period) in December 2010 from 7 schools were collated and analysed, and these were able to identify shifts in test scores across that period of time. The data were age standardised, both in terms of the test scores for mathematics (*Progress in Maths 9,* GL Assessment [31]) and for reading (*Suffolk Reading Scale 2*, GL Assessment [32]). On this basis, progress would mean that test scores would need to increase. The mathematics test was chosen as it was particularly relevant to the needs of this study. The test questions covered a wide range of mathematical topics, relating to the work undertaken in school and at home. It was not a multiple choice test, and it did not focus on a single range of mathematical topics (such as just number, or algebra, or shape and space). The test paper comprised 31 questions in total, and the topics covered number sequencing, data table interpretation, direction and orientation, weight and its measurement, using a tree diagram, number values, lines of symmetry, multiplication, mental mathematics, time, patterning, money, addition and subtraction, interpreting graphical forms, fractions, shape and space, sorting, position value, and missing numbers.

Comparative statistical analyses were run to look for potential impacts of computer and Internet access. For these analyses, the data were aggregated and were not split or analysed in separate school sets. Data in spreadsheet format detailed a number of variables for each pupil: whether the pupil was in Year 3 or 4; whether gender was female or male; the test score in March 2010; the test score in December 2010; the difference between the two scores; whether the pupil had a project computer; and the number of months the pupil had had a project computer by December 2010. Across the complete set of 738 pupils, 542 pupils completed tests on both occasions, providing matched test scores for March and December 2010. For this full matched set, and for certain selected sub-sets, average scores in March 2010 and in December 2010, and average differences were calculated. These are shown in Table 1.

Table 1 Average scores and differences between mathematics test results in March and December 2010.

Description of the set	Number of pupils (N)	Average score in March 2010	Average score in December 2010	Average difference
All pupils with matched data	542	86.6	89.5	3.0
Year 3 pupils	262	85.9	88.8	2.9
Year 4 pupils	280	87.2	90.2	3.0
All girls	289	86.9	90.8	3.8
All boys	252	86.2	88.1	1.9
All pupils with a project computer	288	87.5	90.8	3.2
All pupils without a project computer	254	85.5	88.1	2.6

For all matched pupil results, a paired sample t-test showed that the difference between the March and December 2010 scores was highly statistically significant (t=-8.58, p=.000). Overall, mathematics results had shifted positively and strongly across this period of time. This was perhaps not surprising, given the schools' focus on interventions to raise mathematics attainment, and the specific focus on homework activities involving mathematics practice using resources such as *Mathletics* and *Education City*. In terms of the different year groups (Years 3 and 4), an ANOVA test generated neutral results (for March scores, F=1.232, p=.268, and for December scores, F=1.237, p=.267). In terms of gender groups (girls and boys), an ANOVA test showed that there was no difference in test scores between these groups in March 2010 (F=.397, p=.529), but there was a statistically significant difference between these groups in December 2010 (F=4.577, p=.033). This result indicated that the difference between these two groups had widened across this period of time. Girls had gained more in terms of mathematical abilities to complete the tests over this period of time. From multiple regression analyses (which were able to identify likely levels of predictive impacts of different factors when variable factors were considered in either isolated cases, or when grouped together), when predictive impacts on the December 2010 scores were considered, then the four factors together (having a project computer, gender, year group, and the baseline March 2010 test score) were likely to account for 70% of the differences noted by December 2010, while other groupings (of three of these factors, or two of them, or only one of them) gave a much smaller predictive value. The likely levels of significance of the individual factors (indicated by p values) when grouped in these ways are shown in Table 2.

Table 2 Levels of likely statistical significance of factors on December 2010 scores.

Factor(s)	Individual factor within the group	p scores
Having a project computer	Having a project computer	.023
Having a project computer and gender	Having a project computer	.023
	Gender	.034
Having a project computer, gender and year group	Having a project computer	.024
	Gender	.029
	Year group	.227
Having a project computer, gender, year group and March 2010 score	Having a project computer	.265
	Gender	.003
	Year group	.639
	March 2010 score	.000

Benchmarking and subsequent testing in reading (across the March to December 2010 period) showed statistically significant differences in pupil scores also. For all matched pupil results, a paired sample t-test showed that the difference between the March and December 2010 scores was highly statistically significant (t=-3.778, p=.000). Overall, reading results had shifted positively and strongly across this period of time. The difference between average March 2010 and December 2010 test results for boys was higher than the average for all pupils. For all matched pupil

results, a paired sample t-test showed that the difference between the March and December 2010 scores for boys was highly statistically significant (t=-3.141, *p*=.002). Overall, reading results had shifted positively and strongly across this period of time for boys. This was encouraging for those involved in the project, given the fact that boys generally score lower in literacy tests than girls (although writing is often an area that is particularly weak, and reading rather than writing was the aspect of literacy that was tested through this regimen). The difference in score between March 2010 and December 2010 was also statistically significant in the case of girls. The t-test generated a lower result, but it was still within the realm of statistical significance (t=-2.302, *p*=.022). In the case of year groups, the difference in test results between March and December 2010 for Year 3 pupils was not statistically significant (t=-.592, *p*=.554), but in the case of Year 4 pupils, the shift was highly statistically significant (t=-4.714, *p*=.000). This difference might be explained by Year 4 pupils having had longer exposure to home learning through computers. In terms of effects of having a project computer, for the two different groups (those with a project computer, and those without), an ANOVA test showed that there was no statistically significant difference in test scores in March (F=.246, *p*=.620), in December (F=.297, *p*=.586), or for the difference in scores across these months (F=.006, *p*=.940). Although the presence of a project computer divided the group in some respects in terms of mathematics scores (although it should also be stated that those children without a project computer could have had a computer of their own), it did not divide in the same way when reading results were considered.

The home computer and Internet access gained through this project was one element within a wider educational programme. The focus of activities through the five strands – arts and performance, extended learning, physical and experiential; technological including ICT; and environmental and residential visits - all potentially had an integrated impact on pupils and their achievements. In this respect, the technologies and the affordances provided for social engagement in the home are key elements within a wider framework of activity. Trying to disassociate the impacts of each element was not an intention of this study, but collectively, the impact was gauged through performance indicator changes at a year group and school level across the period of the initiative. Across this time, school performance improved significantly. End of Key Stage 2 SATs results improved, and there were no reports of serious weaknesses in any schools assessed through Ofsted inspections. In 2010, the level of attainment for the project schools in mathematics had reached 74%, and in English it had reached 73%. By the end of the project period, the variation between project schools and the LA average had been halved. Over the period, no school in the project area had been placed in a category of serious weakness by Ofsted inspections. Interview and questionnaire data from teachers, parents and pupils indicated that the computer and Internet access, coupled with abilities for parents to be engaged with their children's learning activities, were important features in terms of success. From a development and outcome perspective, it was the inclusion of the different features brought to the project that were seen as yielding success, rather than any one individual factor on its own.

4. Considering some international perspectives and dimensions

Developments to encourage parental involvement with their children's learning have not of course been restricted to the UK. However, research studies that explore how technologies can be integrated with parental involvement activities have not been at this time widely reported. The fact that a national context is potentially important is clear when we consider the social focus of education and parental involvement in a number of different countries. Insights gained from practices in some other countries show this importance quite clearly. For example: in France, many parents regard certain subjects such as mathematics very highly; in Germany, parents have had responsibilities traditionally to support 'afternoon school' in homes; in the Netherlands, there has been a focus on 'learning to learn' and 'practical activities relating to the local area' in many schools and regions; in Canada, there has long been a strong focus on enhancing rural schools through capacity building in school communities and more recently use of technologies to support those communities; and in Chile, parents have been increasingly encouraged to be involved in support activities with their pupils.

The relationship of parents and guardians to the educational process when considered at a national or pan-national level is certainly not simplistic. As Kelley-Laine [33] stated (p.343): "The relationship between families and schools in member countries of the Organization for Economic Cooperation and Development (OECD) is complex and shifting. Both families and schools are intimately involved in educating young children - but how they identify, conduct and share their responsibilities varies among the countries according to societal customs, and in relation to changing economic and political climates." She went on to say that: "In many countries, parental involvement in education is considered a right. Some, like France, Germany and Denmark, have written such a right into law decades ago, although the nature of this right varies according to country."

A range of initiatives have been put in place over the past 10 years and more to encourage parental involvement with schools. In France, Bonnet and Ouevrard [34] reported (p.1) that: "At the beginning of the school year 1998/99, the Minister for Schools clearly expressed the objective of bringing schools and parents closer together. A national campaign was launched in October with a week of parents in school. There were two objectives. See the school - parents must be able to imagine their child in class, but they must also feel at ease in the school building. Understand the school - information about the school's work must be clearly explained and easily understood by parents. Despite

considerable changes, the relationship between schools and parents remains difficult and the commitment of parents in collective representative bodies is weak. In all cases, parents have a consultative role and are in the minority. Representatives are elected from amongst the members of parents' associations." Although these initiatives support engagement with the school, they do not necessarily focus on parental involvement with children's learning, but the potential roles of technologies to support this form of initiative, although not discussed at that point in time, are now clear.

This form of school engagement has been reported in the case of other countries too. In the case of Belgium, Armstrong [35] reported (p.1) that: "The Department of Education, Ministry of the Flemish Community, has launched a community project called KLASSE. This regular publication encourages the involvement of parents, pupils and teachers in educational issues. Individual initiatives by education authorities and schools have mainly centred on: school reports; additional support for migrants' children both in class and through special lessons to help integration within Belgium (Flemish Community) and re-integration with their homeland; school newspapers to parents; information meetings, for example, linked to educational outings; open days in school; and school parties, social events or sports meetings."

In the Netherlands, particular companies or agencies have supported aspects of parental engagement and involvement. Jansma and Lok-funcke [36] reported (p.1) that: "Ouders & Coo. was established in 1995 as a government-funded organisation to look after parents' interests. It develops and delivers parent training in the Netherlands. Schools and parents can become members of the organisation. The small charges for parent training are met by the School Boards, who receive funds for that purpose from the government. Ouders & Coo. meet and train parents in their children's own school and in several central locations in the Netherlands. The training prepares parents for their roles in key aspects of the education system in the Netherlands, including: the School Board; the Participation Council; the Parents' Council; specific groups; and more generally as parents of children at school. The staff and parent trainers at Ouders & Coo. have developed a wide range of resources. These have been carefully designed to be attractive and easily understood by parents in order to stimulate and encourage their interest in school and the education of their children."

In the case of Italy, Dutto, Zappini and Aste [37] reported more direct involvement of parents with their children's learning, stating (p.1) that: "Parents can be involved in several everyday school events and in the classroom itself in a number of ways: as experts with particular knowledge or skills; as artists to demonstrate techniques or crafts; to share experiences of recent local history; and as helpers in organising activities, school trips etc. Sometimes parents invite classes to visit the places where they work so that children can learn about local craftsmanship and particular professions."

In Germany, parents appear to have had a closer and more longstanding relationship with their children's learning and with the processes of learning through schools. Pupils' resources are often funded by or provided by parents, and traditionally, schools have provided education in the mornings, and parents have been responsible for the completion of work at home in 'afternoon school' (and work at these times is regularly assessed by teachers). Some teachers are now routinely using virtual learning online environments to support 'afternoon school' activities, as well as enabling them to run lessons when they are 'absent'. Some teachers set work to be completed at home online, they will undertake discussions online with pupils, and they may also encourage and involve parents in discussions and in commenting on their children's learning. Here we see that the social affordances of the technologies are being used to support practices that are already culturally contextualised in certain important ways.

There is a continued focus in many countries on supporting children's learning further both through the appropriate deployment of educational technologies and the appropriate involvement of parents and guardians. For example, educational technologies in schools in Chile have, in the last ten years, been a focus of implementation activities for educators and policy makers. It was recognised in 2002, however, that a coherent and comprehensive approach was needed to ensure that, in their context, a 'digital breach' between private sector schools and state sector schools did not emerge in terms of availability of technological tools and resources for students in these two different groups. Projects have been set up to address potential imbalances that might arise, such as the Recoleta Project in Santiago between 2008 and 2011 [38], but these are projects at a local level. With regard to parental involvement in schools, the government view of roles is that they are essential to the education process and that their participation is a necessity in terms of school management and administrative processes. But, as in other countries, the involvement of parents has not always been found to be easy or, on its own, to lead to positive supportive practice.

Overall, however, while the roles of educational technologies to support learning have been explored in terms of implementation quite widely, and while the roles of parents and guardians in enhancing children's learning have been explored, the joint roles of parental involvement and technologies with useful social affordances, and the practices that will define and describe how these joint factors can effectively work together and enhance learning through appropriate forms of implementation (such as the projects reported in the previous section) have not as yet been explored to any great extent within a range of different social and national contexts, or in terms of research through comparative studies.

5. Conclusions

Internationally, it is clear that the roles of parents and guardians in supporting their children's education and learning are recognised as being important. It is also clear that the particularly important features of involvement with learning are also recognised. Separately, we know that educational technologies provide ways to enhance learning, and that children engage with learning activities that are technology-based both in schools and in homes. Yet to date there are few projects that focus on how both of these aspects (parental engagement and technological engagement) can be appropriately meshed together. There are currently few reported projects and limited numbers of reported studies in this field. There has also to date been no large focus on comparative studies, which would look at and explore the importance and features of social and cultural contexts within a number of different countries.

If we are to look at aspects of parental involvement with educational technologies, then the evidence we have to date suggests that there are a number of different social affordances that we should consider and explore further. We know that: recorded and broadcast video clips and audio files can enhance awareness of learning situations within schools, and awareness of learning approaches within classrooms; online resources provided through a vehicle such as a school website, with material that describes elements of the curriculum, lessons and day-by-day activities, can enhance the visibility of current and future learning activities for parents; online resources can be made accessible so that they can be used by children with their parents' oversight, interest and encouragement; presentations that pupils create and make accessible online can lead to discussion and review in homes; and email and texts can be used to alert parents to resources that are available, or to discuss with their children the need for them to complete and return items to teachers. We also know that engagement in children's learning can be supported through technological affordances with populations who have specific ethnic backgrounds but who live in more socially-deprived areas.

The evidence that we have currently suggests that in the future we should explore to a much greater extent the ways that learning activities can be provided and described, so that parents and children are supported through appropriate access and descriptions of how to use 'artefacts' and 'scaffolding'. Although there is evidence that family members, parents, grandparents and siblings can be involved in supporting and encouraging children with their learning, we need to explore the ways that different family members and friends can become involved, and the important roles of lifelong and intergenerational learning, as well as the roles of fathers and paternal role models. In this respect, we also need to understand much more about how levels of enhanced engagement and activity might work for different groups of the population (for groups with different ethnic backgrounds, and living in different socio-economic locations).

Developments in this area are at an early stage, but a research and development agenda in this field has the potential to explore concepts of how we might consider more successfully moving the position of educational endeavour, moving certain learning activities into the home so that these are supported by the school, involving parents and family, rather than taking an educational top-down approach to the concept of de-schooling. At the same time, we then have the potential to look at how we might move learning into family and community contexts more, into arenas of direct purpose, related strongly to real audience and situations. For any successful move of learning into arenas where family sharing and community purpose become a part of the shift, we need to fully understand the socio-cultural contexts, factors and their implications far more. Differences in systemic approaches, socially, culturally, and technologically, have impacts. Knowing of some potentially important and significant differences raises key questions about not only the importance of these different factors within these different systems, but also the ways that systems could begin to identify alternatives of policy and practice, especially when national policy shifts can more readily enable alternative perspectives to be considered. Now that technologies have been developed to support parental interactions and involvement more, we need to undertake a greater range of studies in this field.

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