The Impact of Discontinuities in ICT Resources on Pupils' Transition from Primary to Secondary Education[1]

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Abstract

Technologically supported education has introduced benefits but also challenges to the transition across school levels of education. While resolving some traditional issues, these technologies have in some instances created a new set of discontinuities at both the resource and pedagogic level. These discontinuities arise due to variance between primary and secondary school access and practice, and also between pupils' experiences of access and practice at previous institutions. In this paper evidence is presented from interview, questionnaire and classroom observation data collected from 48 schools during two projects investigating the impact of high speed Internet access (broadband) in English schools. Findings indicate that schools offer different levels of access to technology, and also different activities when using technology facilities. While differences in practice have always been present across and within levels of education, the introduction of high speed Internet access technology has increased the gap between those using the technology as an add-on to existing resources and those embedding the technological facilities into the fabric of the learning environment. A key issue explored

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is the impact of the discontinuity which occurs when primary (elementary school) education becomes technically richer than partner secondary (high school) institutions.

Introduction

Transition poses new challenges

The process of transition from primary to secondary school can be a particularly challenging time for pupils in terms of the new social and emotional environment and also new academic expectations they encounter. Pratt and George (2005) highlighted the concerns of moving from familiar surroundings to the unfamiliar secondary school environment, and a status shift from being the oldest to the youngest in the school.

Marks' (2004) survey of well-being in Nottingham (England) highlighted the primary to secondary transition as pivotal for well-being. Findings showed that 65% of primary pupils were positive about school, compared to only 27% at the start of secondary school. The finding that this loss of positive attitudes on entering secondary school does not recover after the transition makes the need for a successful transition all the more important. In relation to our focus on Information and Communication Technologies (ICT) in transition, computing and sporting activities evoked the highest levels of well-being during the transition from primary to secondary education, higher even than playing, socializing or passive activities. A similar trend had previously been found during the evaluation of Integrated Learning Systems in UK Schools (Cavendish, Underwood, Lawson, & Dowling, 1997). The focus of this paper is on discontinuities that may arise as pupils move from primary to secondary education, and how the relative lack of ICT resources may contribute to adjustment difficulties when pupils reach the secondary level.

ICT and pedagogy

Differences in pedagogy when ICT is used in schools can be effectively categorized by Adams' (2004) three components: hardware, software, and underware. Hardware and software describe the resources available, and underware the pedagogy that drives its use in teaching and learning, i.e. teachers' classroom practices. One difference in such underware, as reported by John and Sutherland (2004), lies between teaching *about* and teaching *through* ICT, which has implications for pupils' learning of subject and/or technological culture. Adams considered this concept of underware to be the most important aspect of ICT in terms of how the pupils are introduced to and engage with the technological tools surrounding them, which ultimately molds the pupils' relations with and expectations of ICT. While the content of secondary lessons will inevitably be more complex, differences in how the content is delivered, i.e. the underware, may make subject matter appear more complicated than if pupils were using their preferred learning style.

For both primary and secondary pupils, Lesgold (2003) stated that computer and Internet use will only have the profound impacts on teaching and learning it is anticipated to have if it is seen as integral to the educative process rather than as an add-on to the classroom environment. If pupils have to re-learn what is integral to the environment, hardware, software and underware, this integration will take longer. It is this discrepancy between those schools embracing and integrating the technological resources and those viewing it as an add-on extra to the curriculum that is widening the gap between pupils' expectations and skills that becomes evident when pupils from different schools meet.

ICT and resources

Resource levels and teacher expertise are often barriers to embedding ICT across the curriculum. This is a feature of many secondary school environments where ICT is focused in a few curricular areas or by a few enthusiastic members of staff. The downside of ICT enthusiasts within schools was however identified in a report by the Office for Standards in Education (Ofsted, 2004) which revealed 'a picture in which pupils' ICT experiences across the curriculum are sporadic and dependent on teachers; in many schools, opportunities to exploit the technology are lost on a daily basis' (p 6). In contrast to the secondary school trend for isolated instances of expertise across the curriculum, Ofsted reported that primary schools showed more effective use of ICT, though this was largely in the core subjects (English, Mathematics and Science).

This aspect of sporadic access was highlighted by Glover and Miller (2002), in schools where funding would not permit interactive whiteboards in all classrooms. Teachers felt this either meant they had to plan ahead and in detail when they would need the equipment and that this hampered spontaneity in their teaching, or meant they had to decide which lessons would use the interactive technology, and which pupils would consider "old hat". The idea of high speed Internet access as an 'always on' technology is defeated in such circumstances, when access is restricted to scheduled islands of innovation at certain times of the week.

The sample schools

Case study evidence was gathered from 37 schools in 2003 and 27 schools (16 the same as in 2003) in the 2004 data collection period. The schools covered rural and urban localities,

across the primary and secondary levels of education. Schools also varied in size, religion and any specialist status. All schools had some level of high speed Internet access, but differed in the connectivity level and length of time they had had this provision. Table 1 identifies the distribution of schools in the two projects, by level of connectivity, level of education and rural/urban location (as defined by the British Department for Education and Skills).

TABLE 1 HERE

The data

Data were gathered in the form of classroom observations of high speed Internet access and ICT activity, interviews with head teachers, and portfolios of teacher preparation and pupil work using their Internet facility. This provided a picture of how schools were using the high speed Internet available to them, and the part it played in effective practice.

From general school practice, we can suggest two dimensions on which school ICT varies, although there is often overlap between the two. These dimensions are level of ICT advancement (resource) and level of ICT embeddedness (pedagogy). Discontinuities in levels of these two dimensions may result in problematic transitions, such as when moving from an advanced primary to a less advanced secondary school. Equally when feeder primary schools vary in their level of ICT advancement or embeddedness this potentially results in a wide range of ICT skills and experience in the new secondary pupil pool. From our observations, there can be a mixture of advancement and embeddedness particularly at

secondary level, where ICT may be present and embedded within some subject teaching (lead by ICT enthusiasts or ICT-related curriculum) but rarely used in other subjects.

The evidence

Discontinuities between feeder primary schools

Discontinuities between feeder primary schools are inevitably exacerbated when more innovative primary schools lead the way in terms of teaching and learning practice with ICT, leaving a gap between themselves and less well equipped primary schools. (Categories of common discontinuities are listed in Table 2.)

TABLE 2 HERE

There were many instances in our observations of innovative primary school classrooms where pupils were excitedly interacting with the interactive whiteboard as part of whole group sessions, but also in small groups which changed throughout the lesson so that all pupils 'had a go'. How the schools used the interactive whiteboards however was where variations in pedagogy arose.

A year six literacy session (in School A) involved two parallel classes using the interactive whiteboard to write whole class reports about the Antarctic. To do this they accessed images from the region to provide ideas for the setting of the report; sound files and video clips of animals in the area to view behavior; and links to newspapers reporting local events. A tick box was available on each class's half of the split whiteboard screen, which they marked to indicate they were ready to exchange files with the opposite class. They

then received, marked and returned the other class's report. Following this activity, pupils commented that their teachers were now allowing them to use the whiteboards, since the teachers had become more confident themselves.

Allowing pupils to take ownership of the tools available to them seems pivotal to them also taking ownership of their own learning. This is a good example of where the technological element is enhancing the learning experience by sustaining pupil motivation and focus on the task, despite the actual technological tool often being nothing more than a container for the programmed learning activity. The teacher input in creating and collating the lesson is therefore crucial.

In terms of management decisions school B (primary) was particularly creative with ICT, trialling and rejecting e-beams (a digital projection facility) which they hoped would be a cheaper way of having interactive whiteboards. After evaluation they felt the e-beams were not particularly successful when used with children (moving near or bumping into the projector, or teachers' hands getting in the way of the signal from the board pen to the e-beam). In the end the cheaper option was not the best and they invested in interactive whiteboards in every classroom, but this shows the school and staff were keen to try to push their use of ICT forward.

This school was also one of the first primary schools in their local region to have invested in class sets of wireless laptops. As they were being partially funded by parents they could be taken home with the children at weekends and holidays showing a commitment by the

school to promoting learning beyond the classroom and school day.

In less innovative schools the interactive element of tools such as the interactive whiteboard was often not utilized, being used merely as a static presentational tool and so offering little more functionality than a blank wall. While presentation might still be delivered electronically, many teachers remained reluctant to trust the technology's reliability, and so were fearful of using Internet resources live in class. Others were concerned that their pupils would know more than they did about the tools and how to use them, and do not want to risk losing control of their role as teacher, or simply lose face in front of their class.

At school C (primary), funding was the main impetus behind purchasing interactive whiteboards, rather than first addressing the pedagogical implications of this for teaching and learning. At the time of observation the tools were relatively new, with most use of the interactive whiteboard being teacher demonstration. While teachers were sharing their materials through the peer to peer network, there did not appear to be an online area to collate useful shared resources and there was no access to the network from outside the school. The school would have benefited from funding for extra technical support but there were other priorities for the school to address first. Observed use was therefore encouraging, but unless they developed their practice further it might hinder further integration of this and related technologies, as well as prevent extension of the curriculum they offered and its availability beyond the classroom. This was something that set such schools apart from those embedding the tools into classroom practice.

In contrast to the general primary school trend for interactive whiteboards, School D (primary) opted for a favorable pupil to computer ratio. The school had 200 computers for its 340 pupils. All year six (10-11 years) pupils had access to a multimedia networked PC with flat screen monitor. The year six classroom also had an interactive whiteboard with PC, Video and DVD projection. There were large plasma screens around the school displaying pupil work. The school made substantial use of an online assessment facility which was connected to each pupil's individual education plan. This combination was seen as focal to the school's approach to teaching and learning, in attending to the needs and abilities of each individual child. Through this the school was able to track each pupil's performance, as well as view general class and year trends. There was a home-school link enabling each pupil to access and continue their work from home via the Learning Gateway.

The online assessment and home-school link meant parents were now more involved in their children's education, and pupils' motivation was said to have grown. The pupils had a positive attitude toward school and learning. ICT was not specifically taught in the school, but filtered to the pupils through the tools and resources used across the curriculum. Learning activities tended to be open-ended and cross-curricular using generic software and Internet-based material, focusing on the development of core skills such as research and collaboration rather than gathering of specific knowledge. This school accepted a number of pupils who had previously been excluded from other schools, and the students were said to have settled well within the school environment. Other improved efficiencies were

evidenced by the staff use of email, shared diaries, shared web spaces, shared contacts, instant messenger and discussion forums.

Discontinuities between primary and secondary school

Table 3 contains a summary of discontinuities between primary and secondary school levels of education. In many instances we saw the primary school interactive educational games on the whiteboard, while secondary schools focused on use of the Internet. This may be a reflection of the different teaching and learning pedagogies across the levels of education, with teacher led group work being more successful for younger pupils, but pupil driven individual research being more appropriate for and encouraged in older pupils.

TABLE 3 HERE

In a small proportion of our sample schools (four primary schools stood out in this respect), we found primary schools engaging in particularly rich ICT activities with their pupils, providing regular opportunities for the pupils to interact with the technologies available to them. For those schools willing to explore the possibilities of using ICT in their lessons, the introduction of high speed Internet access increased many teachers' confidence in the technological delivery of their prepared resources, due to the increased reliability of the high speed connection. Comments from head teacher interviews indicated that 47% of primary and 53% of secondary head teachers felt the high speed connection had increased teacher confidence in using the Internet in class. The high speed connection enabling quick and accurate delivery had also encouraged and facilitated development of such rich multimedia content both commercially and in house, as well as its use live within the

classroom. According to head teacher interviews, 95% of primary and 60% of secondary head teachers felt their teachers' used the Internet in the classroom more since high speed Internet access arrived at the school.

As one specific example in this area, the ICT coordinator at School E (primary) felt that younger children required more bandwidth, as educational sites prepared for them tended to use a great deal of bandwidth due to their rich multimedia content (audio, video, interaction opportunities). Pupils could and did use online subscription multimedia content sites live and instantly with reasonable confidence. This observation is contrary to government targets to provide primary institutions with at least 2mbps, but secondary institutions with at least 8mbps by 2006. In the case of this school, they had the suggested level before the target date but were already pushing its limits.

In recognition of the higher skills base the younger pupils frequently had on entry that the older pupils had not been exposed to, some of our secondary schools were choosing not to provide basic ICT skills lessons to pupils between years seven and nine (11-14 years old). Where rich activity was occurring in secondary institutions it tended to be focused within certain departments or by specific members of staff with sufficient expertise or motivation to explore the possibilities of ICT within their lessons.

A minority of teachers had reservations with whole class Internet searching in that it is not always possible to know what the pupils are searching, and unsupervised browsing can be common in young pupils' searches. In this respect, independent Internet research had more

educational value for secondary pupils who were encouraged and more skilled at self-regulating their own learning activities and products, and again the role of the teacher in the lesson was critical to successful educational integration of the technological tools.

What are the implications of discontinuities?

What is it that is innovative in these primary schools that is potentially lost in transition to secondary school?

At present we have no data on the experiences of this pupil cohort when they move from primary to secondary school. What we do have however is evidence of what is happening across the range from which we can indicate where potential discontinuities may arise and how they might manifest themselves. We have also presented credible concerns from primary school teachers in terms of level of access, resource and practice across primary and secondary institutions.

It would however be wrong to praise the technology in these institutions and not acknowledge the teachers, teaching and school management. The technological tools have been procured, implemented and integrated with the staff and pupil catchment in mind, to optimize usage and benefit to all those involved in its use. While the specific ICT environments varied in these schools, staff enthusiasm for educational use of ICT can be found in all four. It is this element that is a barrier many schools have to overcome before they can begin to embrace educational technologies, and is often why islands of expertise or practice emerge in secondary environments. The learning activities these pupils did when using ICT provide feedback, were colorful, interactive, and ultimately fun! The

application of resources evident in the innovative primary schools showed how individual access to the technologies across pupils' curriculum (even if that just meant all pupils took turns to use the interactive whiteboard) can enhance the motivation to learn and to engage in the teaching and learning activities. However, these four schools with rich ICT activities varied from rural to inner city, from pupils' first language as predominantly English to predominantly non-English, showing that such learning environments can flourish in a wide range of geographical, social and cultural climates.

Disappointment and anxiety or growing up

The implications of these discontinuities are largely evidenced by different equipment and different activities. Secondary teachers also face a class of pupils some of whom have been exposed to high levels of ICT embeddedness in their learning, whereas others will have acquired far fewer ICT skills. A potential problem with this is a mixture of pupil disappointment (having become accustomed to technologies that are exciting and alive) or anxiety (having experienced far less interaction with technology than their peers). When they move to secondary school pupils have to learn how to make the technologies come alive, through use of the correct terms and applications and also their own knowledge and imagination. Is this disappointment and anxiety in response to differing past experiences simply a part of growing up and learning to do things yourself, or should secondary institutions also be providing exciting learning materials and activities to encourage pupil engagement and interest in the subject matter, differentiated according to pupils' abilities?

Full or restricted access

In many cases, pupils successfully utilized the machines in their learning by the nature of being able to take for granted that they were available for their use. While this is a very privileged position, a potential implication of transition to an environment where ICT is less embedded or advanced is that their further educational development may be hampered by varying levels of access across their lessons and curriculum. Loss of such access may impact on motivation and engagement, where focus potentially moves from cross-curricular interaction with live multimedia content to timetabled information search. This could lead to differential motivation and performance across subjects.

Does it all come down to the realization that it is the learner's responsibility to make their learning fun?

The above scenarios cover the fun or motivational element of the interactive activities designed with the younger pupil in mind. This element seems to disappear in resources for older pupils. This was certainly the perspective of the teachers feeling that primary schools required greater bandwidth capacity than secondary schools, in light of the 'richer' resources available for the younger pupils. Ultimately the older pupils do more for themselves, or at least have less done for them in terms of the resources they receive. To take ownership of their learning, the younger pupils have to engage in the learning materials. For the older pupils to take the same level of ownership of their learning, do they first have to create their own learning materials, both practically and motivationally, and could this be this getting in the way of them fully engaging in the secondary school learning environment?

Preparing for transition

A first step to reducing these potential problems during transition would be to make pupils aware of the differences they might encounter. Within some of our sample schools there was recognition that transition can be a difficult time for pupils and they were introducing schemes to ease the process. School F (primary) was part of a ‘Virtual Transition' project. Year six (10-11 years) pupils were paired with ICT buddies in year seven (11-12 years) from their local secondary school. Pupils could visit the virtual tour of the school and there was a weekly open forum as well as set activities. This is however an example of an advanced secondary school helping to ease transition by allowing classes of pupils from technologically less advanced local primary schools to use their facilities. While this strategy is a good example of a step forward, it does not address the real problem of resources being less advanced in the secondary than the primary school, or peers entering secondary school with different skill levels.

Conclusion - Moving forward

This paper has presented evidence of challenges to learning brought about by discontinuities in ICT resources between primary and secondary education in the United Kingdom. Based on observations in 48 schools and detailed study of four ICT-intensive primary schools, the research team found that problems can occur when high speed Internet connectivity and interactive access are not maintained as students move from primary to secondary education. The innovative primary schools and teachers observed in this study are making a positive contribution by embracing the interactive tools available to them to

enhance their pupils' learning opportunities. The unfortunate downside of this innovation and good practice is that learners develop expectations of technology that are not met when they transfer to another school. While some innovative practices are also emerging within secondary institutions, there will inevitably be those institutions that are a few steps ahead both financially and pedagogically.

Implications of these findings are that national and local schemes in place to support procurement and development should be coordinated to ensure that ICT continuity for students moving from primary to secondary education is maintained. This has a particular resonance in the UK at this time because of government plans to reform education and make schools more independent. This independence provides an extra challenge to the coordination and consistency of ICT provision across institutions. A coordinated ICT policy is necessary in order to promote institutions working together to be better equipped, both technologically and pedagogically. This coordination will help them to meet individual pupil needs, benefit financially by sharing resources and student services, and reduce discontinuities apparent in some instances.

Further study is needed to determine whether the adjustment difficulties encountered by students moving from technology and pedagogy rich primary schools to less rich secondary schools are caused by the deficiency or simply coincidental. If causation can be confirmed, then national and local policies may need to be redirected to support both primary and secondary institutions in developing and continuing a high level of technological enhancement where the technological tools facilitate the learning activities.

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Table 1. Distribution of schools by high speed Internet connectivity, level of education and rural/urban location

	Primary (Elementary)		Secondary (High)	
	Rural	**Urban**	**Rural**	**Urban**
Low Connectivity <2 Mbps		2		
Mid-Connectivity 2 to 8 Mbps	8	15	2	8
High Connectivity > 8 Mbps		2	3	8
	8	**19**	**5**	**16**

Table 2. Potential sources of variation between more and less advanced and embedded primary schools

	Less advanced or embedded primary	More advanced or embedded primary
Interactive whiteboard presence & location	None or only in ICT suite	In classrooms and ICT suite
Interactive whiteboard use	ICT classes Teacher demonstration / present static information Start / end of lesson	Teacher and pupil interaction with board Interspersed throughout subject lesson/s
Internet activity	Intranet use by teachers Pupils search pre-opened sites Find information but record on paper Print results	Pupil free search possibly within suggested sites / cached options Find information and enter into program / word document Store results electronically
Content	Printed resources	Interactive programs subscription sites
Staff attitudes to ICT	Operate within comfort zone – need to know basis	Try new things Search to find new ways to do things and new things to do

Table 3. Potential sources of variation between more advanced and embedded primary schools, and less advanced and embedded secondary schools

	More advanced and embedded primary schools	Less advanced and embedded secondary schools
Software	Online, live, web-based subscription sites	Revision and data storage facilities
Applications	Peripherals such as digital cameras, Webcams	None or rarely used
Activity – internet	Search (often intranet) possibly within small number of sites	Less restricted search
Interactive whiteboard	Teacher and pupil control of work through interactive resources Whole class or small group Use throughout lesson/s	Teacher lead and controlled Admin: take register Initial demonstration Whole class Use at start / end of lesson or static point of reference
ICT location	Dispersed - Most classrooms and ICT suite	Centralised - Some classrooms and ICT suite
Hardware	Poorer pupil:computer ratio (7.5:1, Becta, 2005) Marginally better pupil:interactive whiteboard ratio (119:1, Becta, 2005) but largely contained in classrooms	Better pupil:computer ratio (4.9:1 – Becta, 2005) Poorer pupil:interactive whiteboard ratio (126:1, Becta, 2005), but distributed between classrooms and specialist ICT areas