

REPORT 7:

Literature Review in Informal Learning with Technology Outside School

Julian Sefton-Green, WAC Performing Arts and Media College



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FOREWORD





When we think about learning, we often tend to think about schools, universities, colleges. If we go a little further and think about learning outside school, we might begin to consider museums, galleries and science centres. What we often tend to overlook, however, is the sort of learning that goes on as part of our normal day-to-day activities when we don't even think we are learning. Today, however, anyone who has an interest in how children learn with digital technologies needs to look beyond institutional contexts to consider the implications of children's use of computers, mobile phones, digital television and so on as part of their informal day-to-day lives. How are children learning when playing computer games? What are they learning when they create animations or websites on a computer at home? Why are they interested and engaged in using these technologies outside school? What can we learn from these activities that can help us in designing our approaches to formal education?

This review focuses specifically on children's informal learning with technologies outside school. It brings together the existing research in the field to create a map of this digital ecology of education, discussing what we know about which children have access to these technologies, what they are using them for and the implications of this use for learning. Most significantly, however, it summarises the extent to which the research in this area is beginning to raise fundamental questions about how children learn and, consequently, whether we need to re-examine the design of our formal education system.

We are keen to receive feedback on the Futurelab reports and welcome comments at research@futurelab.org.uk

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Director of Learning Research
Futurelab

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EXECUTIVE SUMMARY



children are immersed in ICT-related activities in their homes and with their friends

EXECUTIVE SUMMARY

Computers and other aspects of Information and Communication Technologies (ICTs) allow children and young people a wide variety of activities and experiences that can support learning, yet many of these transactions do not take place in traditional educational settings. In fact many of these may not be considered 'educational' according to our conventional understanding of that term. For most of us, discussion about learning is inextricably related to formal education systems (how schools should be organised, managed and run). However, any interest in the role of ICTs in children's learning forces the recognition that many children are immersed in ICT-related activities in their homes and with their friends. This recognition requires us to acknowledge a wider 'ecology' of education where schools, homes, playtime, the library and the museum all play their part. This review, then, is an attempt to map out the different approaches to understanding how young people may be learning with ICTs in a range of settings outside the school.

The particular focus in this report is children and young people's use of digital resources that are primarily viewed as leisure activities and which, often, are viewed by formal educational establishments as outside the realm of valued educational experience. This comprises, for example, children's playing of computer games, their use of chat rooms, their exploitation of digital media and digital television and so on, in other words, all the activities that are now mediated by digital technologies as part of young people's social and cultural lives.

Section 1 of the report deals with the challenges and methodological issues facing research into children's informal learning with ICTs. It highlights conceptual and political difficulties in researching an area of activity often overlooked or unacknowledged by research, policy and practices. Usually, questions about children's learning in non-formal settings are not asked. However, an attention to informal learning, whether voluntary, accidental or embedded in people's day-to-day lives, also makes more evident the experiential nature of learning as many accounts of informal learning pay tribute to notions of wonder, surprise, feelings, peer and personal responses, fun and pleasure. This section goes on to discuss the difficulties of defining 'informal learning', and the challenges for researchers of mapping where and with what resources children are learning with technologies outside school. It also highlights the fact that knowing how many young people have access to technologies is insufficient grounds for understanding how technology use might support learning.

Section 2 defines key theories of learning which have been or can be applied to observation of children and young people's informal interactions with ICT. These learning theories are important in helping us draw links between children's learning in these contexts and those in school, but this review also highlights how children's informal learning is leading to the need to develop new approaches to thinking about learning in any setting. The four main theories discussed here include 'constructivism', which basically suggests that by reflecting on their own experiences, all learners construct their own

understanding of the world. This approach is contrasted with the pedagogic theories of Lev Vygotsky. The third approach describes 'discovery' or 'experiential learning' with its associated rhetoric of learning through play. Fourth, we examine theories of 'situated learning' which argue that we need to understand learning as a social process and to look closely at socio-cultural contexts. Finally the report describes 'new literacy studies' which attempt to theorise the whole range of ICT-related experiences often described as a kind of literacy (as in the populist phrase 'computer literacy').

Section 3 synthesises a range of academic and commercially-funded research which maps children's ownership and frequency of ICT use in the home and debates the effect of unequal access to the technology. In very broad terms, fairly consistent trends in home ownership of ICTs amongst young people over the last five years show that PC ownership seems to be around 76% in families with school-aged children compared with around 80% for games consoles, 100% for televisions, 90% for mobile phones, 30% for digital television and around 20% for digital cameras. Around 80% of households with children have access to the internet but only about 5% of homes with children have broadband. Predictably, the key determinant influencing ownership of digital technologies is social class.

Section 4 explores the characteristics of informal learning organised in three sub-sections. The first of these focuses on identity, culture and social context, showing how learning transactions are intricately embedded in the immediate social worlds children inhabit. The second looks at play and interactivity focusing on

computer games. This focus delineates three kinds of approaches to computer games: a focus on gaming in its raw psychological sense; an attempt to explore how game play might transform the present curriculum; and an exploration of game playing and game cultures as an original medium for learning. The third sub-section here examines the capacity to use digital media to make and design a range of new media products, and the issues around the learning involved in this new kind of production activity, particularly as it relates to software.

Section 5 offers a series of conclusions aimed at different constituencies of interest. There is a considerable body of research which shows that young people's use of, and interaction with, ICTs outside of formal education is a complex 'educational' experience. We need to find ways for this kind of learning to be valued by teachers, schools and the curriculum.

We need more research examining huge areas of ICT interaction about which we know very little, around interactive TV for example. Secondly we note that most of the studies described above may shed light on small areas of young people's learning but they do not look across domains and across experiences to show how society in general can support and sustain learners.

The evidence collected in this report does suggest that some of the public anxieties about children and ICTs are misplaced. Parents need accessible research to support many intuitions they feel about seeing children learning and playing with ICT in the home.

Teachers and other educators just simply need to know a lot more about children's

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experiences and be confident to interpret and use the learning that goes on outside of the classroom.

The message for software developers is that despite the current interest in educational software, it would seem as if other kinds of product might develop learning in round-about ways. Part of the issue here is that the market for educational software is defined by the very strict limits of in-school education, whereas this report suggests a range of ways which might seek to soften such definitions in reaching the same goals.

ICTs have changed both the scope and the nature of learning

1 INTRODUCTION: THE CHALLENGES AND OPPORTUNITIES OF INFORMAL LEARNING

This review is based on a seemingly simple and obvious premise. Computers and other aspects of Information and Communication Technologies (ICTs) allow children and young people a wide variety of activities and experiences that can support learning, yet many of these transactions do not take place in traditional educational settings. In fact many of these may not be considered 'educational' according to our conventional understanding of that term.

It is well known that children, probably all of us, learn all of the time; that much of that learning is dependent on the tasks and surroundings we find ourselves in; and that we transfer principles and facts from one experience to another. This much was true before computers. However, in recent years a number of commentators have suggested that ICTs have changed both the scope and the nature of this learning, setting up new opportunities for learning new kinds of skills, as well as offering different ways of learning traditional knowledge. Many commentators see in this idea the germ of a movement which holds out the promise of transforming the nature of education altogether.

If we are interested in learning with technologies then, or interested in the role and nature of education, it is important to look beyond what formal education has to offer, to consider the wider 'ecology' of learning.

1.1 SCOPE AND AIMS OF THE REVIEW

This review is an attempt to map out the different approaches to understanding how young people may be learning with ICTs in a range of settings outside the school - especially in contexts not traditionally associated with education. It is aimed at a constituency of parents, educators and software developers who are interested in the very general and broad idea of informal learning and ICT.

The literature in this area roughly suggests three kinds of uses for studying informal learning:

- to help us understand learning in the abstract
- to help us understand and validate a wider range of learning experiences and settings
- to suggest how we might exploit or support informal learning.

This third aim, of finding ways to enhance children's learning out-of school and develop links and connections with educational goals throughout their daily lives, goes to the heart of current political thinking about education and indeed drives much of the mission of Futurelab. Recent years have, for example, seen much speculation about finding ways to harness the learning power of computer games. However, as we will see, the first two aims can have as much 'utility' in developing curricula as the more immediately obvious idea of exploiting leisure time or leisure activities for learning.

When considering children's informal learning with ICTs, we also need to recognise that many of these resources

are of course merely more modern versions of older technologies, in particular TV and video or even books. There has been considerable study of the educational use of TV in the home and in particular the role of children's television in the life of the growing child (Messenger Davis 1993; Buckingham 1993). Where relevant this review will draw on pertinent literature to discuss the principles at work. However, this review will concentrate on the use of digital technologies and especially those which potentially offer a more 'interactive' relationship between users (particularly those which facilitate community) or between user and text than that usually associated with mass broadcasting. This is a shorthand distinction but convenient for establishing limits for the review.

Importantly, however, the focus on learning in these settings raises a number of questions, both theoretical and practical, that we need to address before turning directly to the research literature available in this field.

1.2 WHAT DO WE MEAN BY 'INFORMAL LEARNING'?

In our society it is very difficult to separate the processes of learning from the practice of education. For all sorts of reasons we invest heavily in schools, colleges and universities, and for most of us discussion about learning is inextricably related to formal education systems: how schools should be organised, managed and run. However, any interest in the role of ICTs in children's learning forces the recognition that many children are immersed in ICT-related activities in their homes and with their friends. This recognition requires



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learning in out-of-school settings needs to be accorded status and understanding

us to acknowledge a wider 'ecology' of education where schools, homes, playtime, the library and the museum all play their part. In turn, this has led to a reconsideration of whether schools are good or even practical ways to organise children's learning at all. What is more, an understanding of children's learning outside school settings throws into relief what we might expect, want or need the formal sector to be able to contribute. Indeed one of the aims of this review is to make the case that learning in out-of-school settings needs to be accorded status and understanding as we seek to enhance the education system more generally.

Straightaway, we can see that this focus on the wider ecology of education requires us to reconsider terms we often take for granted. In the first instance, it requires us to ask what we recognise as 'learning'. Many researchers, for example, would argue that all sorts of learning goes on in a range of different settings, and that this learning contributes to the capacity to learn the formal knowledge that is conventionally valued in our society. As has been noted, however, in our society we often don't tend to value learning until it can be categorised with reference to the frameworks of academic disciplines we recognise as 'knowledge' (Coffield 2000; Moss 2001). Some commentators have gone so far as to argue that in today's climate we often refuse to recognise any activity as learning unless we are able to 'certify' it (Sutherland 2001).

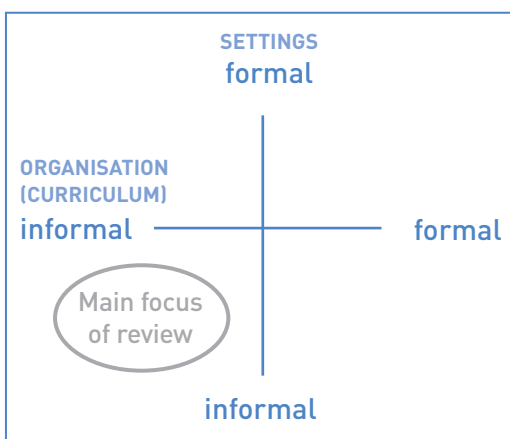
What, then, might we mean by 'informal' learning? Does this 'informality' refer to **how** we learn, **where** we learn, **what** we learn, or the relationship between the activity and what is **valued** as knowledge

today? Does informal learning simply mean learning that happens in a different way from in schools, in a different place, about different things, or does it refer to anything that is learnt that isn't currently valued by our education system?

Today, the term 'informal learning' is used quite loosely to describe all or any of these. Some people use it to describe the location of learning – suggesting that all learning outside the school is 'informal'. Others to describe the purposes of learning – suggesting that all learning that is part of leisure activity, rather than for examination purposes, is informal. One thing is clear, however; the terms 'informal' or 'formal' are not intended to imply that informal approaches to learning are all fun and games, while 'formal' approaches are all seriousness and gravity. Rather, the distinction between informal and formal learning, as we will use it in this report, can more clearly be made around the intentions and structure of the learning experience.

If this sounds rather abstract, another way of thinking about it is to imagine two kinds of continua. The first contrasts formally **organised** learning with casual or 'disorganised' 'accidental' learning (examples here might range from a lecture through to playing a computer game respectively). The second ranges from formal **settings** (schools) through intermediate kinds of learning spaces (like museums and galleries) right through to social structures we don't tend to think of as learning organisations (like families or friendship groups). In other words we could have both formal and informal learning occurring in both formal and non-formal spaces; it is quite possible to have formal learning in the home (doing

homework, for example) or informal learning in a school (smoking behind the bike sheds).



If we consider the subject under consideration in this report - children's out-of-school learning with ICTs - we can see an incredibly broad range of activities and experiences that might lie at different points along these two continua. The home environment alone, for example, may offer a range of different digital experiences for young people, from playing computer games to using revision CDROMs from interactive voting with digital television to editing digital photographs. While in museums, children might use TV studios or blue screen technology to explore film techniques, or play computer games to enhance exhibitions. In the museum sector some of these exhibits are exceptional in terms of scale and cost (for example the robots in the Sony 'museum' in New York), while others seem to serve as little more than advertising for commercial products. The type and availability of resources and activities in libraries and youth centres, moreover, can range from simply 'accessing the internet', to being involved in complex multimedia digital film-making.

At the same time, we need to recognise the growing number of digital experiences that may be explored across a range of different settings through the mediation of the web; from online chat rooms and multiplayer games communities to government-funded initiatives such as Culture Online (www.cultureonline.gov.uk/) and Planet Science (www.scienceyear.com/home). Seen in this way, it seems almost impossible for a review of this length to begin to explore all the features of young people's learning with digital technologies. There are, however, broad categories of activity that we might be able to draw out which will serve to focus our attention in this report.

The first grouping might consist of those experiences organised specifically to support formal educational achievement but accessed in informal conditions. In the home, for example, many children encounter digital resources designed specifically to support the national curriculum, whether through commercial educational resources or through publicly funded websites such as the BBC revision websites. At the same time, many publicly funded institutions, such as libraries, museums and galleries are of course formal educational institutions, albeit not part of the school system. Some of them (like the school visit to the National Portrait Gallery) are often experienced by children primarily as part of their schooling, with visits often structured around the completion of worksheets and viewed by teachers as a key component of curriculum activity.

The second grouping might consist of those activities which adopt informal approaches to learning formally-sanctioned knowledge; in other words,

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there are few studies of children's learning outside of 'education'

resources which encourage engagement with socially valued information and resources through non-curriculum linked formats. The government's investment in Culture Online, for example, is seeking to extend the reach of the UK's cultural institutions through the development of a resource aimed at creating 'virtual' museum experiences. Other experiences that might be considered here include examples such as Planet Science (www.scienceyear.com/home.html).

These examples are in the public domain and are largely produced with the formal curriculum in mind, although the engagement supported by these resources cannot be mapped specifically onto national curriculum models of progression. The experiences of public visitors to science centres and museums might also fit into this category in that the structures by which visitors engage with exhibits may be characterised by non-formal approaches, but the 'knowledge' which visitors are exploring is often socially valued formal knowledge (Bradburne 2001).

The third grouping is of children and young people's use of digital resources that are primarily viewed as leisure activities and which, often, are viewed by formal educational establishments as outside the realm of valued educational experience. This comprises, for example, children's playing of computer games, their use of chat rooms, their exploitation of digital media and digital television and so on; in other words, all the activities that are now mediated by digital technologies as part of young people's social and cultural lives.

Given the growing interest in this 'digital generation', and the emerging challenging theoretical ideas emerging from research

into these activities, it is on this last area that we will focus in this report – although, as will be seen, there are times when it is impossible to draw hard lines between learning experiences. The interest of this review, then, is very much at the informal end of **both** continua, looking at informal learning in terms of both organisation and its settings, at how young people learn in contexts outside both formal educational settings **and** formal educational approaches.

1.3 HOW CAN WE RESEARCH 'INFORMAL LEARNING'?

Defining what constitutes learning in the abstract and whether it can be 'distilled' from informal learning settings is both conceptually and politically complex.

It is conceptually difficult because there is no one simple science of learning, no one set of shared rules to which all researchers in the field would point to begin to describe how informal learning might take place. At the present time, for example, researchers in 'education' continue to struggle with the challenges of combining psychological and sociological approaches to an understanding of learning. The conceptual challenge of defining children's learning outside schools is also particularly problematic as most literature in this field is oriented towards the implications of informal learning for the formal sphere. With some notable exceptions, there are few studies of children's learning outside of 'education'.

It is also politically challenging. These questions about children's learning in non-formal settings are not usually asked

because contexts such as the family or children's peer groups or online cultures aren't usually state funded, and not usually considered part of the remit of public debate. At the same time, it is worthwhile remembering that an attention to informal learning, whether voluntary, accidental or embedded in people's day-to-day lives, also makes more evident the experiential nature of learning, as many accounts of informal learning pay tribute to notions of wonder, surprise, feelings, peer and personal responses, fun and pleasure. Researching the pleasures and wonder of learning is of itself a deeply contested and politically charged arena, with debates often polarising around whether learning 'should', in fact, be 'fun'. However, we are living through an era of intense interest in learning, especially its economic importance in the 'knowledge economy', an economy that, we are often told, will require not only formal educational experiences, but 'lifelong learning' in a range of sites and over sustained periods of time. An interest in out-of-school informal learning is, therefore, much more of a mainstream political concern now, although to date it has not been assigned the same resources as other educational issues.

Besides raising a number of questions about **how** people might learn, informal learning raises an equally provocative set of questions about **what** might be learnt outside of the formal curriculum (besides abstract capacities, like learning to learn). Here a great deal of the literature requires us to re-think what we might mean by 'knowledge' or 'information' and the relationship between 'facts' and 'concepts'. As I have already suggested, considering informal learning helps us refocus on what we might mean by learning in the first

place and helps us return to first principles. Part of the problem lies in the fact that the **contexts** of learning, including teaching, can be observed, whereas the cognitive dimension (the learning going on in an individual's head – or between individual minds) is much more difficult to study. Moreover, from an educational policy point of view, it's easier to influence the **conditions** under which learning may be reasonably expected to take place, rather than learning itself. Unsurprisingly, then, most educational research and study is of teaching and curriculum. Nevertheless, by attempting to investigate informal learning, we have to acknowledge these larger philosophical questions.

Finally, it is worthwhile repeating that, although informal learning takes place in many locations and in many kinds of interactions, this review will focus exclusively on informal learning facilitated by or in interaction with digital technologies outside the school setting.

1.4 HOW CAN WE RESEARCH THE ROLE OF ICTS IN INFORMAL LEARNING?

Researching informal learning with ICTs also brings additional challenges to those described above.

The first, for example, is the challenge of mapping where, and with what resources, children are learning with technologies outside school – where and how significant is the digital 'ecology' of education? At least when researching learning in schools, the area of study is relatively well defined. This question becomes significant when we consider the frequency with

many accounts of informal learning pay tribute to notions of wonder, surprise, fun and pleasure

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which, today, we hear the terms 'digital divide' or 'digital generation'. As Buckingham (2000) has shown, both of these terms are complex and imply broad sociological changes - the first suggesting that patterns of access to digital technologies are instrumental in creating social exclusion, the second suggesting that an entire generation of young people are fundamentally different in their relationship with ICTs from previous generations. Both of these questions have been crucial in generating quantitative and broadly sociological research in this field. Over the last few years, we have seen a growing number of surveys which attempt to map out levels of home ownership and use of ICTs, originating from academic, market research and educational policy institutions.

If we are interested in mapping children's access to technologies in settings outside the home, the problems become more complex. The first major barrier is the lack of publicly available research in many of the sites where young people may be using ICTs - in museums, youth clubs, science centres. There is, to date, no body of work which has systematically investigated the use of ICT in even one area of this wide field. Many evaluations of specific programmes by broadcasters or projects in museums, for example, are commissioned by the project management and rarely prioritise an understanding of learning. Frequently, the kind of information available only offers very broad statistical pictures, eg the use of community ICT centres measures the number of 16 year-olds using the internet in a library (www.dfes.gov.uk/ukonlinecentres). This is important information but does not help analyse the learning going on in such contexts. Studies like Orr Vered (2002) have

explored how ICT might function in state after-school care in Australia, but such qualitative studies are rare in the UK. Moreover, most museums, youth centres and science centres, for example, use ICT in supplementary as well as complementary ways. In these cases it is very difficult to separate the role ICT might play from the wider museum experience.

Even setting aside these difficulties in mapping ownership or access, it has become increasingly clear that these figures would not, in themselves, really explain what people might be doing with ICTs, and of course such statistics shed no light on our interest in the learning that may or may not be going on as children and young people use the technology.

The second kind of approach to explain usage has attempted to address this shortcoming through adopting a qualitative approach. Here close study, often involving sustained observation of and interviews with individuals or families, has offered researchers a 'deeper' understanding of children's out-of-school computer use. This is not to say that larger surveys haven't tried to gauge the quality and meaning of ICT use (see for example the 'technology maps' in Somekh et al (2002)) but that the case study approach enables us to reflect more directly on questions of learning - even when learning isn't the primary research interest. This more detailed case study work allows the researchers to ask fundamental questions about young people's experiences, motivations and interests in using these technologies. However, there are also questions surrounding this case study approach. Often, the young people selected for these studies are extremely motivated to learn and to some extent this approach

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tends to favour 'interesting' or 'cutting edge' technologically-mediated learning experiences. Indeed, within a perspective that sets out to understand learning with ICTs through a case study approach, it is extremely difficult to research those young people who do not want to, or cannot, access ICTs however relevant these examples may be to the wider debate.

Arguably, if we are to understand the nature and significance of children's informal learning with ICTs, we need to understand the literature which draws on both of these research approaches, using the quantitative surveys to provide a corrective to the sometimes over-generalising pronouncements of researchers working in a case study environment, and using the case studies to provide an insight into the significance of the experiences that 'lie behind' the numbers in the questionnaire surveys.

It should also be noted, however, that research into digital technologies is often characterised by a search for what is 'new' and 'different' in human experience. Unsurprisingly, then, some researchers looking at young people's use of digital technologies are more interested in arguing for the difference that ICT interaction makes, rather than any continuity with conventional or ordinary kinds of learning. The sociological approach which emphasises how pre-existing social structures mediate the use of ICTs (Silverstone & Hirsch 1992) however, suggests that there are limits to the extent that technologies can function in and of themselves as a stimulant to new kinds of learning (see especially Facer et al 2003).

This review, then, will begin by discussing the key theoretical approaches to learning

that have emerged through studies of learning in alternative settings and with ICTs and then go on to map out the landscape of children and young people's access to and use of digital technologies outside school. The review will then draw out key characteristics of children's informal learning with digital technologies through case study examples before, in the final section, offering a synthesis of the theoretical and policy implications of such studies.

2 INFORMAL LEARNING WITH ICT

This section will describe key theories of learning which have been or can be applied to observation of children and young people's informal interactions with ICT. One of the key themes underlying this synopsis will be the question of how these theories of learning might characterise informal learning as a distinct intellectual experience and might require a revision of existing theories of 'formal' learning. A second key theme relates to the role of the 'teacher' in informal learning settings. When we think of learning outside school, we often assume that the role of the teacher is absent, and yet what research into this area is helping us to understand is that the role of the teacher, performed either by individuals not formally qualified as teachers, or, indeed, as performed by technologies, is likely to be as crucial to informal learning experiences as to 'formal' learning experiences. None of these theories, however, directly applies to the question of **how children learn informally with ICTs**. This is a new area and the 'road map' of where we need to travel to understand this is laid out through these different theoretical perspectives.

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INFORMAL LEARNING WITH ICT



2.1 THEORIES OF LEARNING

2.1.1 Constructivism and Vygotskian theory

As is well known, the theory of constructivism is associated with the learning afforded by the use of ICTs (in and out of formal education). Propounded by Bruner (1966) and popularised in the computer field by Seymour Papert and his colleagues at MIT (eg Papert 1993), this theory basically suggests that by reflecting on their own experiences, all learners construct their own understanding of the world. Each of us generates our own 'rules' and 'mental models', which we use to make sense of our experiences. Learning, in this theoretical framework, is seen as the process of adjusting our mental models to accommodate new experiences (see Wegerif 2002). Traditionally, it has been the ability of ICTs to offer systems of representation to simulate and model possible outcomes to given scenarios, and above all to be controlled by the user at their own pace, which has led to the idea that ICTs offer a particularly supportive environment for constructivist learning.

As Wegerif (2002) notes, different models of learning emphasise different strengths and weaknesses, and constructivism is often contrasted with the work of Vygotsky (1962, 1978) who articulated a more social theory of learning. Whereas constructivism focuses on the individual mind, Vygotskians (sometimes also known as socio-cultural theorists) conceptualise learning as more socially constructed. Vygotsky's work is well known for a number of features, most of which relate to its use in developing theories of

pedagogy. For example, Vygotsky proposed that we all move from a use of spontaneous concepts to what he called 'scientific concepts'. These aren't scientific in the typical use of the word but refer to informed and shared understanding as opposed to intuitive ideas. Furthermore, Vygotsky is well known for the idea of scaffolded development where active teaching in the right time and in the right place is seen as the only way for learning to take place. He conceived, in particular, the notion of the 'Zone of Proximal Development', which can be described as the difference between what an individual is able to achieve or understand on their own, and what an individual is able to achieve in conjunction with a more expert 'other' – whether a person or a resource. This emphasis on the role of a 'teacher' and on structured, coherent progression also offers our analysis of the computer and progression with say computer games, fertile ways of conceptualising young people's learning in out-of-school environments. Usually, these ideas are employed to describe the interventions made by teachers in classrooms. However, from an informal learning perspective, it is interesting to consider how non-teachers (peers and other 'experts') might fulfill teaching roles. Equally, it is productive to explore how software in general and games in particular might be written to 'scaffold' or support inexperienced users/learners so as to structure 'Vygotskian' learning.

2.1.2 Discovery/experiential learning

At times, constructivism has become entangled with the idea of 'discovery learning' or 'experiential learning' with its associated rhetoric of learning through play.

Whilst some of the pedagogy associated with discovery learning has much in common with constructivism, the theories differ in their philosophical definition of where 'knowledge' resides in relationship to the 'minds' of the learners. It's probably fair to say that most assumptions about the value and nature of informal learning derive from some supposition about discovery learning. Although this approach has become almost proscribed in the current rejection of 60s ideologies, discovery learning is often valued in and of itself in the informal domain. The ability of the computer-related experiences to support experimental, trial-and-error approaches seems very much in tune with discovery learning, which really underplays the teacher's role. However, this needs to be set against a considerable interest in the role of ICTs as providing a structured environment for play, thus affording a more reflective and organised (constructivist) learning. These are common arguments for software aimed at the younger market and can be easily observed in the advertising rhetoric aimed at parents. Besides academic interest in this debate, these theories have influenced public understanding of ICTs and learning. At a simple level we can often find ideas of play, feedback, structure and modelling used to explain learning with ICT. However, the terms are often used superficially and the really exciting work in learning theory over the last ten years has been in other areas.

Discovery learning, however, has also been used to loosely describe the educational philosophy lying behind many developments in museums and galleries, which for a long time have addressed the question of informal learning. The literature in this field, however, does

distinguish between informal learning in non-formal settings and formal learning in non-formal settings, drawing attention to the fact that in many cases museums and galleries offer a non-formal learning of formal knowledge (Bradburne 2001). Even allowing for these distinctions, it should be acknowledged that much of the literature refers to the museum/gallery experience in general rather than that part which could be constrained to ICT (see for example the discussion of kinaesthetic learning (Thomson & Diem 1994) in relation to zoos). The most comprehensive study of learning in museums and galleries (Hooper-Greenhill et al 2003) attempts to offer a framework for reflecting on the learning experience for both the institutions and visitors but does not distinguish between exhibits in terms of the use of ICT. This raises all sort of questions about learning from experience, which may be of interest to developers of software resources and policy makers, but which are not strictly pertinent to this review. In as much as they offer a way of thinking about some of the principles of informal learning, however, these theories will figure in the more detailed studies in Section 4.

2.1.3 Situated learning

The first of the more interesting recent new approaches to learning emphasises processes of **situated** learning (Lave & Wenger 1991). This body of work argues that we need to understand learning as a social process and to look closely at socio-cultural context to make sense of learning (Rogoff 2002). This approach emphasises the nature of the body and real experiences in real contexts. It pays close attention to the webs of knowledge created

in many cases museums and galleries offer a non-formal learning of formal knowledge

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by social practices, especially it should be noted in relation to learning in the work place (Seely, Brown & Duguid 2000). At the same time, this idea of the web or network (Castells 2000) has come to stand as a metaphor for the way thinking and knowledge might work. These theories of situated practices and situated cognition, as with the Vygotskian approach, also pay great attention to the distribution of understanding across social contexts. The interest in children's culture, discussed later in this review, suggests how computer play culture can be approached as a community of practice and thus explains the nature of the 'informal' learning embedded in leisure computer use. This model also helps us reconfigure the role of the teacher and/or expert within the community of learners.

2.1.4 New literacy studies

Finally, I want to invoke the body of work described as new literacy studies. Not only do we now have an attention to a whole range of ICT-related experiences often described as a kind of literacy (as in the populist phrase 'computer literacy'), but research in literacy studies itself explores how meaning is distributed across semiotic domains (visual, aural and text) (Kress & Van Leeuwen 2001). Literacy studies don't just define how texts are made in this new 'multimodal' age, but how readers (or in our case, players or users) learn how to make sense of and use new texts in making meaning (Gee 2003). The new literacy studies also explore the pedagogic structure of texts – that is how the reader is inducted into and then supported through the reading process. This work emphasises that the development and acquisition of new

literacies are not reliant on the traditional institutions of schooling and pedagogy (cf Bourdieu & Passeron 1977; Luke 1989), but are taught and learnt within the wider culture (Green & Bigum 1993; Buckingham & Sefton-Green 1994).

2.1.5 Caveats

This very brief synopsis of learning theories shouldn't just be read as an abstract body of literature which can be applied to the kind of ICT use described in Section 4. In many cases research into the kind of interactions at the heart of our focus is itself changing, driving and developing new theories of learning. Understanding informal learning with ICTs isn't just a question of filling in the gaps, it is much more an area of study which may shed new light on how we learn in the first place. Indeed, a key part of the debate here is that our analysis of learning in relationship to informal uses of ICT might help our understanding of how learning happens in schools and in traditional learning situations (Sefton-Green 2003a). The implicit models of how learning works in respect of the conventional curriculum and school classroom share some of the insights described above, but they also draw on other more established theories of learning which do not help us understand what children might be doing with a computer game or in a chat room. Part of the rationale for the study of informal learning is that putting these debates about how learning may occur in, across and between domains creates exciting challenges for educators in the digital age.

informal learning
with ICTs is an
area of study
which may shed
new light on
how we learn

MAPPING THE DIGITAL 'ECOLOGY' OF LEARNING



3 MAPPING THE DIGITAL 'ECOLOGY' OF LEARNING

This section will bring together, or provide pointers to, the current available survey research data on the availability and use of digital technologies by young people in sites outside school. At this stage, we will refrain from discussions of the implications for learning of this access, and provide this research here simply as a context for reading our later detailed descriptions of young people's learning with ICTs in Section 4.

3.1 OWNERSHIP AND FREQUENCY OF ICT USE IN THE HOME

Ownership of the technology

Both academic and commercially-funded market research show fairly consistent trends in home ownership of ICTs amongst young people over the last five years. This data (see Fig 1) shows that PC ownership seems to be around 76% in families with school-aged children compared with around 80% for games consoles, 100% for televisions, 90% for mobiles, and around 20% for digital cameras. BBC figures also now suggest over 50% of homes with children have digital TV (BBC 2002). A familiar feature in all the survey data is how games consoles displace PCs in less middle class homes. The second key issue in discussion of ownership relates to the internet (see Fig 2).

Although, as we might expect, income is the key determinant here (given the cost of internet use) we also need to take into account access to broadband (including ADSL etc) as speed and bandwidth are the key issues in determining access to a 'first' or 'second class' internet. Recent BBC

figures give around 80% of households with children as having access to the internet and only about 5% of homes with children having broadband (BBC 2002). There isn't a great deal of research about how children's homes are connected to the net beyond general pictures. Equally the spread of digital TV (and Digital TV services) is part of this picture but information is difficult to obtain. Commercial research (BBC 2002b) suggests that 2 to 11 year-olds make up 6% of all home users of the internet and that internet usage is higher as children grow older.

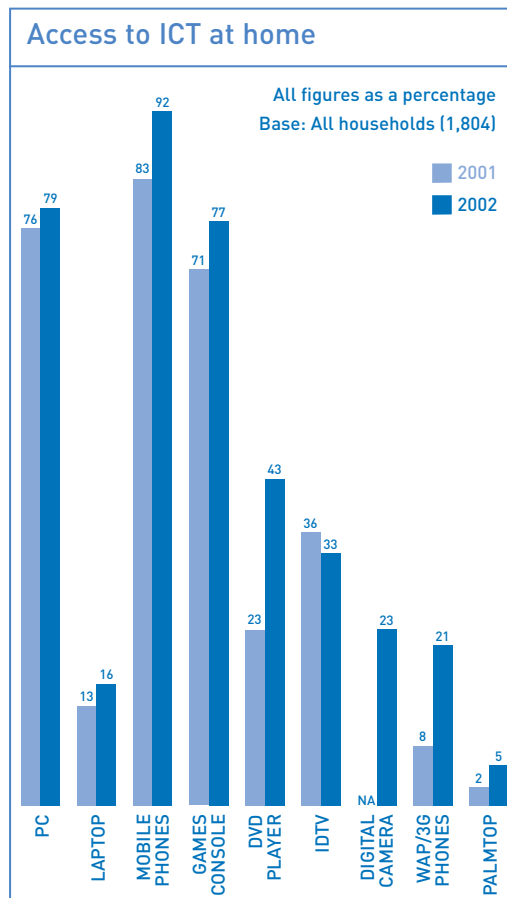


Fig 1: Hayward et al 2002 p12

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Access to the internet at home by key stage of a child and social grade

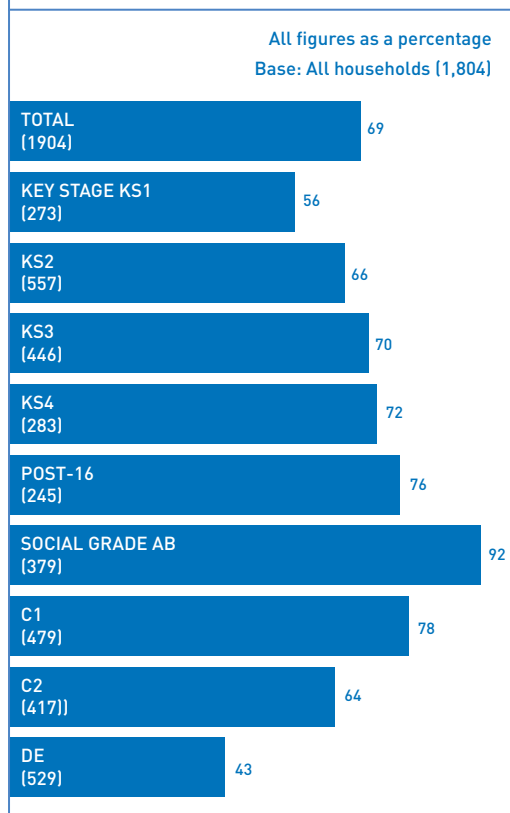


Fig 2: Hayward et al 2002 p14

These studies also provide some insight into the frequency and duration of use of computers in the home. The 2002 Young People and ICT survey (Hayward et al 2002) for example, suggests that on average children aged 11+ use a computer at home for six hours a week (see Fig 3). A regional survey suggested that 33% of children aged between 7 and 18 used a computer every day at home (Facer 2001).

Unsurprisingly, there is significantly less data publicly available on children's use of other technologies in the home, such as

games consoles or digital television. Such research that does exist here is usually conducted for commercial purposes (see the 'kids.net' section on the NOP website for example, www.nop.co.uk) and difficult to obtain. Necessarily the questions such research seeks to ask are related to an interest in exploiting the media. However, commercially-funded research has been at the forefront of finding ways to track what people do online or, to be more precise, which pages and sites they visit. The Net value Home User Panel (quoted in BBC 2002a) shows that 50% of boys (aged 12 to 15) visited games-related sites in October 2001 as opposed to 20% exploring arts and culture. These statistics do not show what is done (or learnt) during such experiences but they do allow for rather generalised 'taste' observations to be recorded such as the 'fact' that boys like sites that allow them to download AV clips of the latest music but are less interested in finding out about song lyrics than girls (BBC 2002a).

One study of the CBBC website (BBC 2003) does reveal trends such as the fact that peak usage is during the week and that

Time spent using computers in the seven days prior to the survey (mean hours) – Key Stage 3+:2002 vs. 2001

	2001	2002
Base: All young people in KS3+	858	974
At home	7.2	5.7
At school	3.0	2.8
Elsewhere	1.3	1.1
Total	11.5	9.5

Fig 3: Hayward et al 2002 p9

page hits have increased phenomenally. It reveals how top requested URLs are the home page and activities (like quizzes and games) and topical TV-related pages. This kind of study also shows how users moved to EastEnders and sports pages from the CBBC site. If such users were children, this would show how the media experiences cross between categories provided specifically for them. The BBC as a provider of media across broadcast, internet and interactive TV services is uniquely placed to explore how the different media intersect with each other in children's lives. Commercial research used by the BBC suggests that the BBC website is used far and above commercial competition (14% as opposed to say 5% for MTV or 4% Cartoonnetwork, BBC 2002a). This BBC research also suggests a symbiotic relationship between media experiences, showing that if

children are motivated by TV programmes they will visit the website of the programme (albeit for limited visits). Research from NOP from 2001 (quoted in BBC 2002b) suggests that most use of the internet is for playing games (60%) with the other uses (in descending order of use) being categories defined as 'fun, e-mails, listening to music and chat' accounting for around 25% of activity. Interactive TV is still in its infancy and research to date, such as Watchams (2002) study of iTV Bitesize has focused on the conditions of use showing how the role of the TV in the living room (it is very rare to get iTV on the bedroom set) is problematic as a medium for revision. A rare qualitative study on BBC's Onion Street (Quaestor 2002), a site for self-supported learning and study, albeit within a formal schooled framework, explored issues of relevance, navigation and content, concluding that although many



if children are motivated by TV programmes they will visit the website

Percentage of 6-17 year-olds who use the medium at all during their leisure time									
	Gender			Age				Social Grade	
	All	Boys	Girls	6-8	9-11	12-14	15-17	ABC1	C2DE
Aged 6-17 (N=1303)									
Television	99	99	99	99	98	100	99	99	99
Music media	86	81	90*	71	83	91	97*	85	86
Video	81	83	79	89	79	79	77*	84	79*
Computer games	64	79	48*	63	70	73	49*	62	65
Book – not school	57	49	64*	67	62	52	45*	64	51*
Comics	36	38	34	30	36	39	39	48	26*
Internet	28	33	23*	42	38	21	12*	29	28
Aged 9-17 (N=980)									
Magazine	66	56	77*	n/a	56	71	71*	67	66
Newspaper	36	38	33	n/a	21	29	56*	33	38

Fig 4: * Statistically significant difference. Source: Livingstone and Bovill (1999: 59)

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different media
complement or
supplement each
other and at
times replace or
displace older
media

of the site's features were attractive, the site's proposition in relation to offering home-learning worked against itself as a web experience.

Less up to date but more detailed information from Livingstone and Bovill (1999) also shows how ICT 'competes' with other media in the home (see Fig 4).

Studies here show how the different media complement or supplement each other and at times replace or displace older media, such as the study of how texting has replaced e-mail (BBC 2003; Thorne 2003). The overall preference for screen-based media is significant, although such statistics show how solid the preference for reading fixed narratives (including TV and films) actually is and how important music becomes as a kind of identity in adolescence.

3.2 ACCESS AND FREQUENCY OF ICT USE IN ALTERNATIVE SITES

The home, however, is not the only site in which young people can use digital technologies. Indeed, much social policy in recent years has attempted to overcome inequalities in home ownership by the provision of computer and internet access in other sites, such as community centres, libraries and museums. These cultural institutions, moreover, are increasingly examining the potential of digital technologies to provide different types of experiences for visitors. At the same time, the internet café has become a familiar feature of many streets in our towns and cities – although there is evidence that the use of such public places is changing (Beavis et al 2003). The impact of broadband mobile technologies (the 3G networks) will be influential here

(Woudhuysen 2003). Research into the use of digital technologies in these different sites tends to be fragmented into, for example, research into 'community access' which focuses specifically on public provision of access to computers and internet, often tied in to an explicit 'ICT skills' agenda (see the Metadata research site: www.unl.ac.uk/ltri/research/ukonline.htm) or research in the field of museum and science centre education. There is rarely, if ever, any overlap between these perspectives and approaches that would enable someone interested in this field to map out the similarities and differences in the types of provision in these sites; there is often no specific focus in museum education on the role of interactive exhibits and there is little research on children's experiences across these different sites (GLA, 2002).

The research that does exist in this area suggests, however, that levels of use in these sites are significantly lower than in the home (see Fig 5), with only very rare cases of continuous or iterative use – which is essential on the whole for an educational interaction.

The key UK government initiative dedicated to the provision of ICTs outside schools is UKOnline (www.dfes.gov.uk), which draws together a number of recent initiatives aimed to ameliorate social exclusion in this area. However, despite the fact that DfES collects data from UKOnline sites, it is difficult to get any sense of how young people make use of these resources. Other government initiatives which have clearly funded opportunities to access ICT outside school include New Opportunities Fund (www.nof.org.uk/), after-school programmes and a range of Arts Council of England (www.artscouncil.org.uk) initiatives like New Audiences. Whilst

How often do you use a computer (NOT a games console) outside school						
I use a computer	Never	Less than once a month	At least once a month	About once a week	2-3 times a week	Every day
At home	12	4	5	14	31	33
At a relative's house	44	24	14	12	5	2
At a friend's house	27	26	22	17	7	2
At my parents' workplace	77	11	5	2	3	1
In a library, museum or science center	58	23	10	6	3	1
At a youth club/ youth group	84	5	3	5	2	1
In an internet cafe (cafe with computers)	86	8	3	2	1	1

Fig 5: Computer use outside school (n=1818, valid %s reported, rounded up) (Facer 2001)

information on broad numbers of use is available, and details about all such programmes available online, more precise data describing young people's use of these resources is not.

3.3 DIGITAL DIVIDES?

As already mentioned, one of the key issues driving the large scale survey research in this field is the concern that the introduction of digital technologies to many aspects of our day-to-day lives, as part of our work, leisure and educational experiences, may be leading to the exclusion of those people who cannot, or do not want to, own and use these technologies (Schon et al 1999). Research in the US, in Australia and here in the UK has identified a number of broad sociological patterns in terms of access and use of technologies by young people. While there is not space here to reference

all the literature in this important area, it is worth noting that a number of discussion groups and publications on this subject are available (eg Loader 1998; Webster 1995; Facer 2002).

Predictably, the key determinant influencing ownership of digital technologies is social class – with more affluent families having significantly greater ownership (eg 90% for PCs). Trends consistently show that whilst the mobile telephone is a relatively 'democratic' technology, internet access is more restricted. Class (or in this instance, wealth) overrides all other determinants (gender, ethnicity, regional bias) in explaining ownership (see Fig 6).

Ownership of the technology, however, is not the same thing as access to it. In other words, owning a computer or mobile phone does not necessarily guarantee the opportunity to use that technology. Current

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Household access to ICT – by social grade					
	Total	AB	C1	C2	DE
Base: all young people	1804	379	479	417	529
	%	%	%	%	%
Personal computer	79	93	86	81	60
Laptop computer	16	36	17	11	3
Personal or laptop computer (net)	81	95	89	82	61
Mobile phone	92	95	92	93	88
Games console	77	70	77	83	79
DVD player	43	46	47	45	34
Interactive digital TV	33	33	36	37	26
Digital camera	23	37	27	22	11
WAP/3G	21	27	25	21	14
Palmtop computer	5	12	5	2	1
None of these	1	—	—	1	2

Fig 6: Hayward et al 2002 p12

Media environment in child's bedroom and elsewhere in the home, by family composition						
	Family type (N=1275)		Siblings (N=1302)		Mother in paid work (N=939)	
	1 parent (%)	2 parent (%)	Yes (%)	No (%)	Yes (any) (%)	No (%)
Media-rich home	27	50	47	36	52	39
Media-poor home	43	25	29	33	23	31
Traditional home	30	25	24	32	25	29
Media-rich bedroom	24	24	23	32	22	28
Media-poor bedroom	28	23	25	20	20	28
Other bedroom	49	54	53	48	59	44

Fig 7: Livingstone and Bovill (1999: 51)

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studies would suggest that the key factors, in respect of access are family structure, gender and age. Predictably, the older the child, the greater the chance of accessing the technology. Boys have greater access to PC than girls – though this is statistically less significant than one might suspect, and certainly it is (statistically) not a simple causal explanation for gender-differentiated computer use.

Livingstone (2002) describes a range of what she calls ‘household mediators’ of ICTs access showing that there are always important exceptions to these general trends. Her work with Bovill (Livingstone & Bovill 1999) also identifies the development of the ‘digital bedroom’ for older children (9+) where children may have exclusive access to digital technologies in their own bedroom space (Fig 7) as opposed to an older model of shared family access in communal space, though as other case studies show (Facer et al 2003/ 2001a), this kind of provision still exists.

It is important to emphasise, however, that being able to access technology does not necessarily determine how that technology will then be used. Indeed, one of the defining features of research over the last few years has been to emphasise that technology ‘itself’ does not **determine** how it will be used, but rather, that ways of using the technology emerge through a complex interplay between children’s expectations, family cultures and features of the technology. In order to understand this, we need to move beyond the statistical surveys that we have referenced so far, to the case studies of children’s use of technology.

4 CHARACTERISTICS OF INFORMAL LEARNING

In this section, we move from the generalised surveys of access and use and, using the theories outlined in Section 2, identify some of the most significant features of children’s informal learning with ICTs outside school, paying, as we outlined above, most attention to those practices currently overlooked by formal education policy, practice and research. This more detailed study of informal learning draws on a number of detailed case studies and is organised around three key themes emerging from the research literature at the present time: the significance of culture, motivation and identity (with reference to online experience); play/interactivity (with reference to computer games); and production/design (with reference to digital productions).

4.1 CULTURE, SOCIAL CONTEXT AND IDENTITY

This section examines the role played by children’s and/or youth cultures in the models of learning which emerge from studies of the social use of ICT, and the ways in which these models overlap with contemporary trends in learning theory, in particular theories of situated practice (as described in Section 2).

Most studies of children’s or young people’s use of popular media are extremely interested in questions about culture – though not usually from an educational perspective. Instead, this research is often driven by a series of adult concerns about the changing nature of ‘childhood’. For example, Kellner (2002)

being able to access technology does not necessarily determine how that technology will then be used

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or Buckingham (2000) are very concerned with the role of the market and commercialisation in young people's culture. ICTs, it is argued (eg Nixon 1998), have been at the forefront of this process, both driving the leisure market into the home and in turn being driven by convergences in marketing (see also the studies of Pokemon in Tobin 2003).

Another key area of concern around children's digital cultures has been the development of largely uncontrolled (and probably uncontrollable) child and youth participation in the growth of internet culture (eg Savigar 2001). Chat rooms in particular have been the subject of considerable press interest especially in the context of a fear of predatory paedophiles. Moreover, the highly sexualised nature of many children's experiences in chat rooms seems part of the same drive to induct children into the adult world of the commercial marketplace (Meyrowitz 1985). These kinds of concerns inevitably feed into debates about regulation of children's cultures. (www.ippr.org.uk/research/index.php?current=25&project=72).

This aspect of children's cultures is a good example of the kind of new domain where out-of-school and in-school experiences collide and intersect as schools are now required to teach the skills to 'protect' children in their out-of-school experiences or where parents look to formal education for understanding about what their children do in their leisure time. Arguably, however, schools are some of the least informed sites to be able act in this way.

As Buckingham (2000) has argued, these adult anxieties about children's cultures have often over-determined our research,

leading us to ignore other aspects of these practices that may be worthy of greater attention. There is a burgeoning body of research literature, however, that takes a more open approach to the threats and opportunities embedded in children's digital cultures.

One study of children's use of chat rooms for example (Willet and Sefton-Green 2003) highlights these as places in which new models of learning are occurring and young people are given opportunities to explore new ways of communicating and new forms of being. Based on data collected at a community arts centre in London, the study analysed the interactions of four to six girls, aged 10 to 13, as they engaged in a chat room (Habbohotel.com). The research showed how the girls are 'playfully' taking risks, experimenting and negotiating meaning as they engage with discourses around pre-teenage girls. Far from showing children as the passive innocents in a dangerous world of strangers, this kind of study shows how children assert control and agency online, using the virtual as a means of cementing local close peer group relationships. These kinds of studies also show how ICT experiences function as 'learning cultures'. They do this in a number of ways. This study showed how young girls were inducted into the peer world and, by drawing on quite formalised teaching and learning roles in their talk, demonstrated how learners are much more flexible and demanding in their social leisure cultures than might be expected. Like the studies of computer games this facility to adopt teaching and learning roles in play contrasts with what we might expect from children and shows how they have taken such pedagogic structures from school into informal use.

research is often driven by a series of adult concerns about the changing nature of 'childhood'

Another key area of interest in children's cultures is the ways in which young people's social agency may be transformed by access to new technologies (Tapscott 1998; Lewis 2002; Katz 2000). By this, I mean that as the computer makes no concession to age, the occupations and opportunities traditionally seen as an 'adult domain' are now open to those young people with access to the new technologies. Lewis's (2002) study of young entrepreneurs, or Katz's (2000) portraits of young 'geeks', emphasise young people acting independently from their traditional carers and, masked by the anonymity of the internet, interacting with adults as their social equals.

Of greater interest to this report, however, is the question of how some young people come to be able to operate in these domains. Many of these case studies are American and although a key part of these approaches is to stress a notion of autodidacticism – of self-teaching and self-motivated learning – these studies often reveal how the family plays a key role in supporting the learning which enabled these (remarkable?) young people to become artists and entrepreneurs. Abbott's (1998) description of a few English web entrepreneurs shows particularly how fathers (or in other cases highly educated male family members) play a key role in fostering high-tech skills and in this respect, these kinds of narratives belong more to those accounts of learning which emphasise the cultural capital of privileged families. The kind of learning described in these case studies is collegiate but relies on the transfer of abstract knowledge and often direct 'traditional' teaching of, say, programming skills within families.

However, Katz's (2000) study of Idaho 'geeks' also draws attention to the principle of an ecology of self-teaching where learners are able to find information they need and are able to construct curriculum and progression – to organise their own learning. These examples might describe informal learning but the object of that learning is frequently the arcane formal knowledge of, say, programming or web design.

This interest in self-teaching is frequently constructed not so much as a study of talented individuals but as a study of 'interest-communities'. For example, Tobin (1998) conceptualises the peer support networks as Otaku (the Japanese term of a 'stay at home' tribe). Here an attention to peers (especially the role of experts), a direct 'need to know' approach to learning, and a focus on real world goals all offer a model of learning which differs significantly from the traditional classroom. The emphasis is on networks or webs where the young people are in contact with other knowledge sources (or nodes) within bounded 'communities of practice'.

Another key area of interest in these studies of children's digital cultures, whether computer games players, web users and especially mobile phone technologies (Harkin 2003), is the commitment demonstrated by the users to these activities. All of these studies underline how this learning is predicated on a high degree of motivation. This is not just the obvious kind of engagement that one might expect learners to show in matters that they were interested in, but a particular focus on an emotional kind of involvement in the use of ICT. This has been described by researchers as young people using ICT-based activities as part of

children using the virtual as a means of cementing local close peer group relationships

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learning is predicated on a high degree of motivation

their construction of their own personal identity (Livingstone 2002; Facer et al 2003; Turkle 1995) in which learning to use the technology is not simply a process of acquiring useful skills, but strongly embedded in the young person's immediate social world and instrumental for these individuals in maintaining and constructing a sense of self. This is especially acute in studies of computer game players (eg Sefton-Green 2003; Gee 2003) and we shall return to this issue of 'intense learning' later. Of course, part of the theoretical interest in motivation is explicitly set against its implied reverse and studies which contrast the motivational involvement demonstrated by learners often explicitly measure their findings against the generalised norm of everyday schooling. For all the need to consistently improve schools, these studies often negatively stereotype typical school experiences.

If we are to really understand the full range of learning processes young people experience in their informal uses of ICT, then children's and youth culture as well as the cultures developed by the commercial media companies need to be explored thoroughly. From the existing research to date, however, the practices involved in children and young people's digitally mediated cultures seem to suggest that:

- many young people are used to working within communities of practice, or communities of learning, in which they take on roles of teacher and learner and induct other individuals into their group activities
- some young people are growing used to operating as equals within adult domains

- some young people are actively teaching themselves a range of skills and competencies either as part of their peer group cultures, or as mediated by digital technologies
- these modes of learning behaviour need to be recognised and further developed in schools and the curriculum.

4.2 PLAY AND INTERACTIVITY

Ever since the earliest development of computer games, there has been intense interest in the medium (Wolf 2003) as a special 'new' opportunity for learning (Greenfield 1984). As computer games have grown in popularity, and as they have achieved an unparalleled position in terms of youth culture and economic importance (Poole 2000; Screen Digest 2000), so this interest has grown exponentially. For example both the UK education establishment in the form of the Becta Computer Games in Education project and the US premiere educational research establishment (MIT) in its Games to Teach project (along with \$12 million input from Microsoft) have taken on the ambition of explaining the potential of computer games for education.

The main reason for both of these initiatives is the fact that on the surface it looks as if computer games are more 'successful' than schools in attracting interest and motivation from young people. This is part of a wider crisis about contemporary schooling common to many Western societies where it appears as if commercial initiatives like the computer game industry are winning the competition for the hearts and minds of the young. Computer games are, of course, not a single form (possibly not even a single

medium in terms of platform) and the nature of the games playing differs widely. As the study of the medium and its use has become developed so literature defining and describing game play has become more sophisticated (Wolf 2003).

In broad terms there have been three kinds of approaches to the study of the educational value of computer games. The first approach has been interested in the notion of play and cognition. The games studied or made under this umbrella (eg www.ioe.ac.uk/playground) focus on gaming in its raw psychological sense rather than attenuated for most computer games culture so prevalent in leisure use of ICTs.

The second approach (exemplified by the studies above) has attempted to explore how harnessing the motivational nature of game play might transform the curriculum as it is currently constructed (Dawes & Dumbleton 2002; Squire 2002; Fabricatore 2000). Issues of role-play, simulation, scenario modelling, intense experience and motivation are all discussed as ways of re-framing the traditional curriculum.

A particular concern in classic educational studies has been the alleged (relative) underachievement of boys and many case studies have focused on the fact that ICTs offer a way of supporting success for boys. This argument can cut both ways in that computer games have been blamed for stimulating violent behaviour (in boys: see discussion in Cassell & Jenkins 1998) or ICT use for reinforcing traditional male control of exclusive high status technologies (Holloway & Valentine 2003). However, the US-sponsored Games-to-Teach project (Squire 2002), the UK TEEM research (www.teem.org.uk/) and the

Becta Computer Games in Education project (<http://forum.ngfl.gov.uk/WebX?14@@@.ee738de>) have all identified examples of the motivating use of ICTs for boys both in and out of school. The argument around the underachievement of boys is of course more complex than simply a need to offer more computers to boys in education (Epstein et al 1998). However, all of these studies note how features associated (though not exclusively) with a masculine approach to learning are prioritised in informal ICT use. These include clear rules and goals (notably in computer games), bounded, de-limited problem solving and an emphasis on practice, repetition, trial and error, (experimentalism) and systems of reward. Practical problem solving and inventive solutions also appear to appeal to male modes of learning. Some studies are reluctant to essentialise male and female models of learning but all the attributes listed above appear as positive, and at times unique, features of learning with ICTs outside and in contradistinction to formal learning.

However, as Fabricatore (2000) has noted, this attempt to harness the motivational features of games for traditional learning objectives is open to the criticism that it may foster second rate games in the pursuit of educational software. Other commentators have noted the difficulty simply of incorporating games in education as though the contexts for play and the construction of learning and knowledge were not in conflict across these domains. Futurelab's partner publication 'Literature Review in Games and Learning' (Kirriemuir and McFarlane 2003) deals in more details with these debates.

it appears as if commercial initiatives are winning the competition for the hearts and minds of the young

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high quality games rather than educational software are the most effective 'educational' approach

The third approach to the study of games has been to explore game playing and game cultures as an original medium for learning. This is not to deny the relationships that do exist between learning in computer games and learning in other kinds of education (Sefton-Green 2003a), but as an approach it concentrates on exploring how players learn to play games in informal settings and the nature of that kind of learning. The most fully developed study here is by James Gee (2003) who focuses on games playing as a form of situated learning. He emphasises how the game-playing environment facilitates active critical learning with a play on and with identity. He explores notions of apprenticeship, practice and group membership and how the movement between and across semiotic domains supports a broad-based development of literacy. His study continually engages with the differences between game playing and schools as complementary (competitive?) sites of learning and he pays close attention to the situated, cultural nature of the learning experience.

This is a rich and suggestive study. Its close examination of the game-texts enjoyed by young people shows how game playing might function as a site for informal learning. It does not acknowledge that games are, of course, merely software programmes and as such the game playing is simply a complex way of interacting with fixed and variable rules, but it does show how immersion in the alternative 'world' of games supports the learning process. Like Fabricatore's (2000) analysis, it argues for high quality games rather than educational software as being the most effective 'educational' approach to the subject. Gee's approach to the vexed problem of content is equally provocative.

Whilst most of the study of games in education are concerned with how to use game playing as a way of 'teaching' the traditional content of education, Gee's approach focuses on how games playing works at a meta level, teaching a kind of thinking much more in tune with many of the demands made in the post-industrial labour market (Cope and Kalantzis 2000). This approach focuses debate very clearly on how schools, curriculum and the software industry might appropriate and use our understanding of the learning afforded by game playing in a wider approach to reconceptualising learning.

Although this rejection of the use of computer games as an educational technology to mediate traditional 'formal' learning may fly in the face of the kinds of government sponsored initiatives discussed above, Gee's approach actually resonates very strongly with the principles of learning described in Section 2 above. In particular, we can see a high level of consonance between the science centre movement and that articulated by Gee.

The science centre movement, exemplified by the San Francisco Exploratorium and the work of its founder Frank Oppenheimer (www.exploratorium.edu), made the case that authentic science education needs to be founded on principles of access and engagement. The new science museum experience offered dynamic, personally meaningful engagement with structured 'discovery learning'. Inevitably, this movement created its own orthodoxy with a world-wide movement in science museum education now replicating the originality of the San Francisco experience. However, the ideal of offering new environments where learning is self-initiated, self-

sustaining and self-motivating could be offered (more economically) in computer games. Gee (2003), for example, explores the similarity between the 'projective identity' games players adopt in certain types of games and the idea of learning how to behave like a scientist in terms of taking risks, using appropriate discourse and adopting the role of a scientist in their work as opposed to doing what they were told. Similarly, the attention in museum and science education exhibits (Bradburne 2001) to the need to support dialogue and the group or collaborative learning is clearly facilitated as a kind of learning behaviour in computer games play. The final point of convergence between these models of science learning in alternative sites and computer games relates to one of the key aims of science learning as articulated by Frank Oppenheimer – namely how to facilitate public debate about the social and political purposes of technology. Gee argues that the capacity in many computer games to offer a 'moral' engagement with high-end science fiction scenarios actually offers a much more informed form of ethics education (offering choice and simulation) than is usually supposed. He provocatively argues that games have "an unmet potential to create complexity by letting people experience the world from different perspectives" (Gee 2003, 151). This approach is absolutely at odds with the popular views that game playing encourages a simple form of identification within the fiction of the games, producing anti-social behaviour (Provenzo 1991) as best exemplified in debate around the Grand Theft Auto games (see www.gameonweb.co.uk).

Contemporary study of games and games playing suggests that:

- the 'culture' of games playing (the contexts, peers and surrounding texts) creates a productive background allowing for complex intellectual engagements
- games themselves provide a unique and demanding environment for learning
- the study of games further develops our understanding of how new literacies really function in practice and point towards the changing nature of communication modes
- the kinds of learning 'achieved' especially by boys through games playing, needs some kind of 'reconciliation' with the formal curriculum.

4.3 PRODUCTION AND DESIGN

This section describes both a new practice (the capacity to use digital media to make and design a range of new media products) and the issues around the learning involved in this new kind of production. Clearly, ICTs offer the ability for users to make and build a range of products. These range from writing and image manipulation to audio, video and web-based production (Sefton-Green and Buckingham 1998). Furthermore, as has been pointed out by a host of commentators (eg Abbott 1998), the web offers the possibility of publishing and distributing these products which in a prior era would be private – or at least only available to local audiences. Additionally, it is now possible for young people to make other 'non-expressive' products including programming or participate in businesses. Whereas the preceding sections have explored commercially driven 'new' leisure



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products (eg games, chat rooms) our interest here is in the use of computers to allow young people to make, communicate and disseminate their own views and creative expressions - including those with innovative design, intellectual or economic possibility. The focus here then is very much on the relationship, or affordances between user and software. Much of the interest in ICT use outside of formal education actually focuses on this area of use as is evident from the surveys and quantitative studies about ICT use, above; however the details of what young people are actually doing is remarkably under-researched.

Kress (2000) and Gee (2003) use the term 'Design' from New Literacy Studies as a way of conceptualising the social and cognitive processes involved in the making of new media. They (and others, eg Fiske 1987) note how the boundaries between producer and consumer (traditionally embodied in the model of an author of print of mass media texts and the reader of those products) is significantly different when playing with or using interactive texts. In these new kinds of texts (Snyder 1997) the reader or user needs to make or 'perform' the text as a kind of 'co-operation' with the writer. Gee (2003) suggests how the nature of game playing supports the sort of design skills we normally associate with game makers and how eliding the world of games playing with education may well develop learning through the design process (see also www.wac/sharedspaces). The argument here is that the closed rule-bound nature of games stimulates an understanding of structure and function and that being required to strategise transforms passive or spontaneous understanding (to use Vygotskian terms) into more formal

'scientific knowledge'. Projects like those described by Beavis (2001) or Willet and Sefton-Green (2003) explore how we need to think of playing computer games as a kind of writing and thereby acknowledge the design process that is involved in game playing. These design processes can be further developed in digital production.

Before we welcome this as evidence of new approaches to learning, however, it is clear that this research agenda needs more empirical research into design processes in action (eg Burn 2000) and indeed into how users cycle through the design, making and playing circuits to fully explore the design processes in learning. However, the attention to design as a key 'multiliteracy' and as one integrally supported through leisure uses of ICT, is a key feature of contemporary curriculum debate (for a model of these theories put into practice outside the UK system see the Australian 'New Basics' initiative: www.education.qld.gov.au).

To an extent however, the use of design (in this sense) in education has remained rather conservative or at the least 'academic' and has not actually resulted in much practice or curriculum development: it has not fully exploited the production potential of ICTs. The websites, film and especially music (Green 2001; www.vjs.net) made by young people in their 'digital bedrooms' or with peers, on the other hand, may offer exciting opportunities for some more privileged young people, but this is precisely the area in which we can see informal learning failing to re-connect with the formal curriculum (www.wac.co.uk/sharedspaces). The research that does exist has looked at digital production broadly as a community of practice (see Tobin 1998; Buckingham

Harvey and Sefton-Green 1999) and emphasised how these activities relate to social networks. Studies of young web designers (O’Hear and Sefton-Green 2003) have also recognised the key role that access to software plays in addition to access to knowledge and knowledge networks. This particular study examined how students’ work in HTML web design, object-oriented HTML construction software and early work in Flash influences the formal models and, more surprisingly, the content of student authored writing online. This attention to production technologies is of course inseparable from other factors influencing the writing process – in particular the genre young web writers choose to work in. However, these kinds of studies show how our understanding of what young people might make, and how they might express themselves, is intricately related to the potential and possibilities of social context and production technology.

Sefton-Green and Parker (2000) have examined commercially available animation software aimed at the younger market. This study explored how young children (5 to 9) used commercially produced animation software - aimed at the home market – in a casual schools project aimed to introduce students to the experience of editing. They concluded that such activities might develop moving image literacies but that the digital ‘edutainment’ software used in the study constrained what was possible. This finding was extended into the conclusion that better quality, accessible editing software is needed for these age groups (see also www.dvineducation.org). Sefton-Green (1999) suggests that because access to software is such a fraught political issue (because it entirely relates to questions of

equity), the value of different kinds of production software or indeed how software plays a role in developing children’s ICT competence out of school are, to an extent, speculative. There are studies of how, for example, spreadsheets can be used in education or how the Lego-Logo matrix of programs might develop programming skills and mathematical understanding (see studies in Scrimshaw 1993 or McFarlane 1997), but we do not have studies of how children of different social worlds may use or have access to different software experiences. In this respect studies of gaming are more advanced as the texts under discussion are more commonly shared.

In general, there has been remarkably little study or research into production software. Whilst there has been considerable interest in developing educational software, the educational use of production software in general has been neglected. Studies of developed forms of youth culture (cf the current vogue for Flash, Manovich 2002) need to be set alongside the commercially structured possibilities for creative production (cf Lego club (<http://club.lego.com/>) or Kahootz (www.kahootz.com.au/)). At the same time studies of hackers and hacker culture (Himanen 2001; Raymond 2001; Katz 2000) show how an ethnographic approach to computer culture might be productive for studies of education and learning.

This area of study is, to date, less developed than the previous two sections but shows how:

- the conceptual models of design and production developed in new literacies study help us understand how children

the educational use of production software in general has been neglected

CONCLUSIONS AND IMPLICATIONS



it is probably impossible to find out how all children and young people might be learning with ICTs out of school

and young people work as authors in the new media

- the range of software and progression through software currently available for children and young people is limited and limiting
- we need informed and detailed understanding of how of young people interact with a wide range of software outside of the formal, 'taught' environment.

4.4 CAVEATS

Of course, even if we were to aggregate all the case studies in the literature, we would have the problem that they may be un-representative of wider computer use. On one level, it is probably impossible to find out how all children and young people might be learning with ICTs out of school but these case studies do suggest rich or 'indicative' insights and it is these insights which guide our understanding about the nature of the learning that might be going on when children are using computers in the home.

Of course, finding out about low or non-users of ICT is methodologically difficult and although it sounds almost perverse to ask the question, trying to describe conventional or non-innovative learning of ICT-related interactions is important because as policy extrapolates from the kind of case studies I have already described, it may ignore unsuccessful or non 'educational' learning. Facer et al (2003) and Tobin (2003a) have studied non-motivated users of technology and, like Hellawell's (2001) analysis on why low income communities don't access the web even when the technical

limitations were overcome, show how a pre-condition for use of ICTs is interest and access to social networks within which ICT is valued (Facer 2002).

5 CONCLUSIONS AND IMPLICATIONS

This section will try to extrapolate key findings from the report for targeted audiences.

5.1 RE-DEFINING LEARNING IN THE WIDER CULTURE

A common thread seems to repeat itself as we proceed through this survey. This would state that there is a considerable body of research which shows that young people's use and interaction with ICTs outside of formal education is a complex 'educational' experience. The kinds of learning demonstrated both complements and supplements learning going on in schools and this has two implications:

- that teachers, parents and other educators need to find a way beyond 'narrow' or simplistic definitions of learning and education to value and build upon the learning described in this study to enrich and support the curriculum
- that the kinds of knowledge and the modes of learning exemplified in out-of-school informal learning is very relevant to learning how to become a modern kind of worker and that the formal education system needs to find ways to intersect with this kind of learning as a valid curriculum aim.

5.2 RESEARCHING LEARNING

Our second conclusion relates to what we don't know. It has proven challenging to find qualitative studies of learning and learners in alternative sites of learning. Digital TV, museums and galleries have data describing the volume and timing of usage but we can find out little beyond that. As a result this report has been slightly skewed towards the home and leisure uses of ICT. Clearly there has been an incredible interest in education in the last decade but most of this has been quite narrow and focused on the kinds of learning and knowledge we already recognise and value. However, without data, understanding or a conceptualisation of what might go on in these other sites, our sense of how these other experiences can support, develop or complement the curriculum will be a little haphazard. As a number of the initiatives described are state funded, it is a real problem if research and evaluation in these areas cannot take place without the perspectives of 'alternative learning' described above. At this stage there is a clear need to understand how, for example, young people might use Planet Science or DARE (www.dareonline.org) (curriculum resource websites) outside of school. There is also very strong contiguity between BBC-produced supplementary material (both as digital TV and online like www.bbc.co.uk/science/cavemen) and the curriculum, and of course there is the 'digital curriculum' produced by the BBC exploiting broadcast resources for education. Not only do we need to know how digital TV as a medium supports learning by being available immediately and in 'context', but we need to know how learners transfer knowledge and other kinds of understanding learnt in these domains to other educational experiences.

One really key absence from the research literature describes any connections across domains. Scholars have been keen to explore say computer games (or other media) or learning in the home (or other specific sites) but have not traced how connections, patterns, links and learning might criss-cross across and between domains. There is a need for research which explores the holistic ecology of learning – if we can allow such a phrase – in the way that, say, Tizard and Hughes (2002) can offer in respect of very young children. Because there is considerable political mistrust and at times antipathy in educational circles to the widening arguments we have encountered, it has been difficult to really understand how young people function as learners 'in the whole of their lives' at school and not at school, on computers and in museums and so on. Most of the studies described above may shed light in small areas of young peoples' learning but they do not look **across** domains and **across** experiences to show how society in general can support and sustain learners.

5.3 LEARNING IN THE HOME

For parents the implications of this report might seem more confusing. On the one hand much of the theory and data suggests that left to themselves children can get a lot from experiences like games or chat rooms which periodically get slated in the press for their demonic and un-educational properties. The evidence collected does suggest that some of the public anxieties are misplaced but this is not to suggest that questions of balance or 'diet' can be left to the marketplace. Whilst many parents pursue software and other respected 'educational' uses of ICT in the

we need to know how learners transfer knowledge learnt in these domains to other educational experiences

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home in their child's leisure experiences, and feel anxious and competitive in respect of investing in their child's life opportunities, the kind of research described may seem only more irritating and confusing. There are a few examples of studies of parents (Buckingham 1996; Messenger Davies 1993) who have embraced Media Culture in ways which allow for support, intervention in and, most importantly, validation of their child's learning and experiences. More 'confidence building' of this sort is needed to balance the debate here.

5.4 SCHOOLS AND THE CURRICULUM

Nothing is going to replace the importance of schools in educating the young in our society, nor is any other system likely to be able to play a role in overcoming social inequalities, but the formal education system is both under attack and in development from a number of directions and from a number of perspectives. There seem to be two main implications for schools and curriculum here. First, teachers and other educators just simply need to know a lot more about children's experiences and be confident to interpret and use the learning that goes on outside of the classroom. Especially for teachers of young children, we need an educational culture that can draw on a wider model of learning that that allowed for at present. Secondly, we need to work within various curriculum locations to develop links with out-of-school learning experiences on offer. We have to find a way also of overcoming the fact that not all children have equal access to all experiences but acknowledge the real diversities in children's lives to support productive curriculum development.

5.5 ICT DEVELOPMENTS AND DEVELOPERS

Those with a commercial interest in providing hardware and software for education will find this report ambiguous. It goes without saying that any high quality products will always be useful but one key theme from the literature is that products do not need to be 'educational' to support learning in practice. Indeed, despite the current interest in educational software, it would seem as if other kinds of product might develop learning in round-about ways. Part of the issue here is that the market for educational software is defined by the very strict limits of in-school education whereas this report has suggested a range of ways which might seek to soften such definitions in reaching the same goals. The second area where commercial developers might find this work useful relates to the need to produce accessible and varied production software. Here the interest isn't so much on customised curriculum resources but on offering viable alternative ways to take advantage of the host of production possibilities offered by new technologies.

The third area for future work would need to examine both what and how young people actually do when using digital technology for making, sharing and communicating. I know of only a very few studies of software and learning outside of the curriculum (Tony Wheeler from TAG Developments has shared with the author an interesting attempt to create a taxonomy of production software; or Sefton-Green 1999) where attempts to explore the learning affordances supported by different software might shed light on the interrelationship between informal learning and software use. This kind of

children can
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work points to the way learning is 'translated' across software experiences but it also shows how the politics of 'Wintel' circumscribe and delimit creative possibilities in the ways that the new wave of software produced say for OSX (on the Apple Mac) for a limited period and at a particular moment in time, may offer other alternatives – albeit to a select few. The review of the literature exploring digital production in education (Burn in press) points to a limited study of digital video editing software, but this is only a fraction of possible software used by young people and only highlights the need for more study in this area. In particular, the whole issue of age related and/or 'stepped' software is a crucial area for further research and development.

5.6 FINAL CHALLENGES

The central argument of this report has been to make the case that new and different kinds of informal learning are occurring outside of the formal education system and that there needs to be culture-shift to accommodate insights from research in this area. Advocates of the 'new times' facing contemporary societies are particularly keen to support the kind of knowledge or network learning identified in this report. However the key to understanding informal learning is to fully acknowledge the necessary dialectical movement across, between and through the sites and kinds of learning available to children and young people today. This report has made the case that in their leisure, at play and in the home with their friends, young people can find in ICTs powerful, challenging and different ways of learning. The emphasis is on sharing, working together, and using a wide range

of cultural references and knowledge. This mode of being emphasises the capacity to make, to author and to communicate. It is completely dependent on the interest of the marketplace. At times this vision clearly scares schools and the formal education system, but unless education policy makers can find ways to synthesis learning across formal and informal domains, our education system will become the loser in the long run.



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