Review of the Research Literature on the Impact of Multimedia Revision Web Materials

Report for the BBC

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Executive summary

This document focuses on two questions:

1. What literature exists regarding school students' use of online curriculum support and revision resources?
2. What are the recommendations for a longer-term, in-depth piece of field research in this area?

In order to address these questions, a variety of research databases, journals, reports, policy documents and web sites were reviewed to draw together research evidence.

Models of use

- Most children (84%) use the Internet daily or weekly and 90% of these use it for homework (Livingstone & Bober, 2004).
- There is evidence that students who use an online revision service perform better than those who do not (Osbourne, 2007; Kelley, 1999) and that computer use by children at home is linked to higher attainment (Punie et al, 2008). However this could be accounted for by the extra time spent studying rather than the medium or be due to the class inequalities associated with home computer access.
- Interactive online resources can increase confidence and motivation (Valentine et al, 2005) but printed notes may be preferred to online ones (Macedo-Rouet et al, 2009).
- Students particularly like receiving instant feedback, the ability to record their progress (Krechowiecka, 2005), diagrams and simulations, and formative assessment (Livingston and Condie, 2004).
- Young people tend to use a variety of web sites depending on their purpose, but continually return to trusted sites (Cranmer, 2006). The degree to which students use revision sites is often greater than is expected by teachers (Livingston & Condie, 2004).
- Students will select which sites to use based on function and content first, then ease-of-use and appearance (Hughes et al, 2004) and site loyalty is determined by the quality of the system, information and service (Lin & Lee, 2006).
- Students prefer to use ICT at home rather than school because of the levels of autonomy offered (Stevenson, 2008) and online revision sites support children to take increased responsibility for their own learning (Condie & Livingstone, 2007).
- Home use of ICT tends to be informal (Sefton-Green, 2004), with a single child on one computer, and activities where the learning outcomes are most obvious being less popular (Somekh et al, 2003).
- The degree of teacher engagement with the online resources and community is crucial for take up (Beanland, described in Krechowiecka, 2005)
- Online social networking is used by the majority of students and email and instant messaging is almost ubiquitous (Luckin et al, 2008) but most online communication takes place with friends that are known face-to-face (Livingstone & Bober, 2004).
- Online communities have the potential to foster interaction but can be undermined by school authority structures (Manchester Metropolitan University, 2003).
Media richness

- There is some evidence that a multimedia format can lead to higher attainment than a traditional format (e.g. Vernadakis et al, 2008; Evans et al, 2008; Jones, 2008) but the research in this area is limited and inconclusive.
- There is also evidence that recognised benefits of multimedia use with adults do not always hold true for children (McTigue, 2009) and that increased media richness can lead to greater cognitive overhead and decreased learning (Acha, 2009).
- Multimedia use in classroom setting can fail to meet its potential because of over-structuring of tasks and curriculum constraints (Hennessy et al, 2006).
- Learning from interactive multimedia is not necessarily correlated with fun or usability (Sim et al, 2006).
- Factors that influence engagement with interactive multimedia include levels of distraction and vividness of the media, the logic and instructions presented, and relevant prior knowledge possessed by the user (Rodrigues, 2007) and rich rather than superficial interaction is essential for engagement (Dunlap et al, 2007).

Learner diversity

- Technologies can support students with learning difficulties by providing a platform for training and rehearsal and by making learning available in new ways (Abbot, 2008). Interactive, media-rich web sites provide a forum for practice, feedback, clear progression structures, visualisation and explorative environments.
- Inequalities of access still exist in terms of class (Lee, 2008; Aslanidou & Menexes, 2008) with an estimated 30% of pupils in the UK having no access to a computer at home (Smith et al, 2008). The UK Government has recently set up a Home Access Task Force to address issue of access (Becta, 2008) but this may still not address underlying inequalities such as support or attitudes (Selwyn & Facer, 2007).
- Online learning sites such as BBC bitesize were identified as key contact points for young people not in education, employment or training (Citizens Online and National Centre for Social Research, 2008).
- There is evidence that online learning has a greater impact on boys, students who are eligible for free school meals, and those for whom English was a second language (Osbourne, 2007).

Recommendations for future research

There follow two recommendations for future research and suggestions for ways in which these recommendations could be carried out:

1. A large-scale mixed-methods investigation into the learning and motivational effects of interactive multimedia on different types of learner.
   - Large scale experimental evaluations to compare different types of learning materials usage (e.g. multimedia vs traditional, different degrees for interactivity) with different types of learner.
   - Online survey of learners to review current practices in formal and informal settings.
- In-depth interviews (face-to-face and online) with learners, teachers and parents to examine current practice and use.
- Data collection on technology use in informal settings using video diaries and camera-phones.
- Expert analysis of a sample of interactive multimedia web resources in terms of learning design and usability.
- Analysis of user interaction in online community discussion forums.

2. A developmental investigation into the potential of integration and exploitation of elements of the web 2.0 philosophy (e.g. collaboration, sharing, production) into the design of online learning resources.

- Ideas-generating focus groups with young people and other stakeholders, adopting a participatory design approach.
- Initial prototype development (paper or wire frame) and user testing.
- Development of recommendations for online learning design encompassing web 2.0 principles.
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1. Introduction

This report provides a review of the research literature on the impact and use of online multimedia revision sites.

This document focuses on two key research questions:

1. What literature exists regarding school students' use of online curriculum support and revision resources?
2. What are the recommendations for a longer-term, in-depth piece of field research in this area?

The first question is the predominant focus of this report and highlights three areas of the research literature: the current models of use of such sites; the effect of rich media web resources on learning; and the impact of such sites on diverse learners.

The research described in this report aims to address such questions as whether and how young people’s use of online resources differ from their use of traditional learning resources, how do users make decisions on which online resources to use (for example whether they stay with a single resource or ‘pick-and-mix’ from multiple resources) and how exactly do young people use such sites. Evidence will also be highlighted to show how effective online curriculum support is compared with offline media, and the impact of online learning communities such as those that support the BBC Bitesize web materials.

It aims to examine the impact of rich media web resources, considering any effects of increasing interactivity and the use of multimedia on learning effectiveness, and whether the use of rich media and interactivity makes a difference to different types of learner. The report will also consider issues associated with learner diversity such as how BBC Bitesize and similar sites might support less academic learners, and whether gender differences exist in the use of online resources and, if so, what they are.

The report is structured in four main sections; after this introduction there follows a brief description of the research strategy employed. This is followed by a longer section that considers the literature that addresses question 1, broken down into three sections that examine models of use, media richness and learner diversity. The report finishes with a discussion of the key themes emerging from the literature and presenting a number of recommendations for further research.

It is important to note that this report represents a small-scale desk-research study, and can only aim to highlight the main pieces of evidence and research work in this area rather than providing a comprehensive review. It is also an area in which limited evidence currently exists in relation to some of the questions posed, and there is a clear need for further robust and in-depth studies in this area.

2. Literature review strategy

In order to address the research questions described in the previous section, a variety of research databases, journals, reports, policy documents and web sites were reviewed to draw together appropriate research evidence to address the core question of what literature exists in relation to the use of online multimedia revision sites such as that provided by BBC Bitesize.

A variety of search terms were used to interrogate these sources to identify literature that dealt with the appropriate age range, type of resource, delivery mechanism and type of evidence sought. The keywords identified and core queries used are described in Appendix...
1. The variety of abstract and full-text databases, journals, web sites and other services that were used are detailed in Appendix 2.

The scope of the literature reviewed focussed predominantly on work carried out with Key Stages 3 and 4 but does include relevant evidence from Key Stages 1 and 2 and from post-compulsory education. The focus is on both formal and informal uses of resources, inside and outside the classroom, and on the UK and US, although, where relevant, research from other countries is included. Studies reported in a language other than English were not considered and the primary focus was on literature from the year 2004 onwards as this is such as fast-moving field and some previous major issues (e.g. cost and speed of home Internet access) are no longer as pertinent.

3. Findings from the literature

This section considers the literature that exists regarding school students’ use of online curriculum support and revision resources, and presents evidence from the literature on three key areas, namely: the ways in which online interactive revision sites are being used; the effects of media richness and interactivity; and the impact of learner diversity on usage.

3.1 Models of use

There exists a great deal of evidence as to the different ways in which young people use technology and the Internet to support their learning, both in school and at home. This section explores some of this evidence, particularly in relation to the use of online multimedia revision web sites, and what can be learned from this body of literature. The access of young people to and use of the Internet at home and school has been growing in recent years, and as far back as 2004, in the UK Children Go Online (UKCGO) study, which investigated 9–19 year olds’ uses of the Internet (Livingstone & Bober, 2004), found that most children use the Internet daily or weekly (with only 16% as occasional or non-users). The study also found that among the daily or weekly users, 90% of the children surveyed use the Internet for homework.

Davies and colleagues (2005) describe a number of benefits of digital technologies and online resources for learning with the 14–19 age group compared to traditional learning. These benefits can be organisational, such as the ability of online resources to support specialist learning and institutional collaboration to increase student choice, and the ability for students to plan personalised pathways of education provision. They can also support the teaching process, by providing the ability for staff to monitor student progress online (for example via e-assessment or e-portfolios), and provide increased flexibility for learners through the provision of ‘anytime, any place learning’, reaching non-traditional learners and learners outside formal education (for example through the use of workplace simulations). Online technology can also enhance existing pedagogic approaches, such as enabling independent and collaborative learning, as well as developing new modes of teaching and learning (such as synchronous electronic discussion, blogs or computer games). Using the Internet for learning can make the delivery more interesting, use of multiple media (in particular graphical media) to offer alternative ways of presenting hard-to-grasp topics, support experimental simulations (enabling students to experience otherwise dangerous or costly activities) and support student research. With the vast number of resources available online, the selection of appropriate resources from the Internet is the most important factor from learning (Clinch & Richards, 2002).

Evidence exists as to the comparative effectiveness of online curriculum support compared with offline media. For example, to research the effectiveness of online revision sites (in particular the SAM learning site) Osbourne (2007) collected data from over 11,500 Year 11 GCSE students. This research found that students who used an online revision service performed better at GCSE than those that did not (although it is not entirely clear whether
this is compared to those who revised in other ways or those who did not revise at all) and this effect could be due to the fact that those students who are more motivated or interested are more likely to spend more time revising and are more likely to achieve (i.e. there may be no direct correlation between revision time and achievement). There is other recent evidence (Punie et al, 2008) that computer use by children in the home is significantly linked to higher levels of attainment (even accounting for differences related to socio-economic status). Of course, this correlation could simply be due to the increased time spent studying or the fact that those students who were more motivated anyway chose to undertake more studying online. However, while there is a positive correlation between hours of use on an online revision site and GCSE attainment other studies provide evidence of a relationship between time spent on any homework and attainment, although in this case this only explains a small amount of variance in students achievement scores (Sharp et al, 2001). Kelley (1999) found, in a trial of over 100 students, that used the BBC Bitesize revision materials for four months before their GCSE examination period led to, on average, a grade higher achievement. This is compared to factors such as teacher influence, which was found to produce no significant difference. This link could be due to the fact that the use of the BBC Bitesize materials is additional (i.e. is not being compared to an equivalent control group of students spending a comparable amount of time on traditional learning) and this is held up by the fact that the same study showed that an additional revision week was also found to have an impact on attainment.

Valentine and colleagues (2005) found evidence that using ICT at home increased students’ confidence and motivation. ICT was regarded as making homework less boring and more interactive and interesting. They also found, unsurprisingly, that online revision sites were more likely to be used closer to exam time. Their study found that “In year 11, use of revision web sites was extensive. Online revisions sites are overwhelmingly popular and well used.” (p33). However, there are also potential negative impacts of online materials. In a recent study Macedo-Rouet and colleagues (2009) compared students’ performance and satisfaction using web-based materials – in the form of notes and quizzes – compared to printed ones. They found that students expressed a preference for printed notes, saying that they are easier to read, and that the group working with the printed documents had a higher performance. The authors hypothesise that this may be due to the higher perceived cognitive load of processing web documents.

Cranmer (2006) studied young people’s use of the Internet for homework, undertaking a qualitative longitudinal study with 17 families and suggesting that “learning at home is neither unproblematic or socially-neutral” (p303). The paper argues that parental contribution is key to homework success but that factors such as time and perceived parental academic ability can limit this. Within the study the majority of examples of students using the Internet for homework were for children between the ages of 11 and 15, either with a parent or alone; younger children tended to work with the support and guidance of a parent. Most examples of use centred around the use of the web to search for information, in particular images. The study found that young people tend to use a variety of sites depending on their purpose, either ‘trusted’ or the results of searching. BBC Bitesize was provided as an example of a trusted site that the children return to again and again.

Young people use online rich media interactive revision sites, such as that provided by BBC Bitesize in formal and informal ways, but the tendency for home use is informal. Sefton-Green (2004) defines three characteristics of informal learning: children’s’ digital cultures, social context and identity; play and interactivity; and production and design. Sites such as BBC Bitesize clearly exhibit these characteristics in the form of elements such as collaborative communities and social networks, game-based learning and interactive multimedia.
An evaluation of the GridClub educational site (a partnership between Channel 4 Learning, Oracle and Intuitive Media, on behalf of the government) that contains rich media resources and a collaborative community, carried out by Somekh and colleagues (2003), provides some evidence as to the ways in which children uses sites of this nature. The GridClub site is aimed at 7–11 year olds, and there will clearly be some differences in use between this age group and older age groups, but this research does provide some interesting insights that could be transferable. The researchers found that home use of the site was usually alone on a single computer (while computer use was often shared at school because of the limited student access to computers) and those games and activities in which the underpinning learning objectives were most obvious were least popular. This highlights an important issue of how to make learning engaging within this type of environment while still enabling students to be aware of, and reflect on, what has been learned; this issue is likely to become even more relevant for older children and adults.

In terms of student study preferences and deciding which online resources to use, Hughes and colleagues (2004) carried out research with over 650 school students between the ages of 14–18 on their web site preferences. They found that students preferred sites that contributed to academic support (e.g. BBC Bitesize), search engines or sites relating to particular enthusiasms. The BBC Bitesize site was by far the most popular for helping with school work. The main reasons given for liking a particular site were function and content (58%) followed by ease-of use (16%) and appearance (10%). Students will tend to use a variety of different sites, but having favourites to which they return again and again. Lin and Lee (2006) provide evidence, based on a survey of 165 online community members, that the three factors of system quality, information quality and service quality are important for determining member loyalty (through user satisfaction and behavioural intention).

Krechowiecka (2005) describes a survey undertaken as part of the government’s 14–19 Pathfinder project in Cumbria into students’ use of revision sites, in which 772 year 11 pupils responded. The respondents reported that they particularly appreciated the motivation of instant feedback and the ability to record their progress. It also highlighted that it benefited students who were shy of communicating in a classroom, that the preferred site for revision was BBC Bitesize (used by 83% of those who accessed multiple sites), and that it was also useful for teachers to be able to track students progress and identify areas of weakness or difficulty.

In a study of privileged families’ use of ICT at home and school, Stevenson (2008) found that the students preferred to use IT at home rather than school because of the increased autonomy offered. The study also found that peer group networks were important for providing informal support for ICT and discussing their use. Condie and Livingston (2007) also highlight that many students use revision materials to check their own knowledge and identify gaps in their understanding, thereby taking greater responsibility for their own learning. In research on students’ motivations for undertaking additional study sessions (not online in this case but still of relevance here) Sharp and colleagues (2001) identified six reasons why students elect to attend study support sessions. These include that it is enjoyable, that they can get help with their learning, disruptive students do not attend, there is a more relaxed atmosphere, they have ability to work with friends and better than working at home (because the environment is less noisy and distracting). It is clear that all of these factors – bar the final one – apply to the use of online multimedia learning environments, and so are likely to be factors that influence students’ usage.

The extent to which students use online sites and online revision materials is often different from that expected by teachers. In an evaluation of Heriot-Watt’s SCHOLAR programme, which provides comprehensive textual and interactive materials to Scottish students studying for Higher and Advanced Higher Examinations, Livingston and Condie (2004) found that the students were using the materials to a much greater extent at home that was expected. In
particular they appreciated the diagrams and simulations, as well as extensive use of the assessment activities during revision, as they provided immediate feedback on their activities. The degree of teacher engagement with the online resources and community is crucial for take up. Beanland (described in Krechowiecka, 2005) says that "Teacher engagement is key; if the teachers believe resources are worthwhile and communicate that to students, they will get used. We've found web-based revision appeals to those pupils who would otherwise be slow to get started. Boys in particular are more likely to revise from web-based materials than from books."

Kerr and colleagues (2003) identify a number of characteristics of successful learning communities: shared ownership and equality; history of collaboration; flat hierarchies; time to develop trust and relationships; built-in formative evaluation and a positive ethos. The ways in which learners take part in the communities that support online learning and revision sites has also been the subject of research. Manchester Metropolitan University (2003), in the study of the GridClub site, found that the communities associated with the site had the potential to foster interaction between children and adults, a sense of belonging and peer learning, but warned that “the norms of authority within schools can undermine the opportunities for a Community of Practice.” (p4). In a recent large-scale study of web 2.0 for learning, Luckin and colleagues (2008) found that social networking was used by the majority of students surveyed (74%) and the use of email and instant messaging was almost ubiquitous. The BBC Bitesize web site was the preferred homework web site by 24% of respondents, however few learners reported engaging in collaborative learning for school work (although some reported ‘chat’ about work). There is also evidence that most online communication takes place with local friends rather than people they have never met face-to-face (Livingstone & Bober, 2004).

### 3.2 Media richness

This section examines the impact of the use of rich media on learning. There is little real evidence in the literature on the comparative effects of using multimedia and traditional teaching methods (possibly because of the difficulty and ethical issues associated with setting up studies of this nature). Kay and Knaack (2007) discuss a meta-review of the research literature on evidence for the impact of learning objects (described as “interactive web-based tools that support the learning of specific concepts by enhancing, amplifying, and guiding the cognitive processes of learners”). They conclude that there are a number of problems with many of the existing evaluations of learning objects in that the focus is on technology before learning, they do not provide estimates of reliability and validity but instead over-rely on descriptive data, they focus on impressions rather than specific features, concentrate on either formative or summative evaluation, or are carried out on small sample populations.

In one comparative study of traditional and multimedia methods of teaching the skills of shooting in basketball, Vernadakis and colleagues (2008) found that there was no difference in immediate recall on a written test but that retention and attitudes towards the online methods of teaching were favourable (a possible issue with this study, however, is the use of a written test to evaluate a skill). Evans and colleagues (2008) used a randomised trial to compare a text format of teaching chemistry students with an interactive multimedia format. The study found that those students using the interactive format had a small, but significant advantage. However, this advantage did not prove to be as significant as SAT score or gender (where males had the advantage over females). The authors describe four advantages of the rich media format as being the use of narrative, access to an interactive exploratory environment, provision of a variety of contexts for practice, and access to immediate feedback. It is not clear from the study the extent to which each of these factors might effect learning.
In research with primary school children and the use of multimedia to learn mathematics, Jones (2008) found evidence that there is value in expressing mathematical concepts in different modalities. While there is recognised evidence for the benefits of multiple media for learning (e.g., Mayer, 2001) there is also evidence (McTigue, 2009) that established multimedia learning benefits of using graphical representations for learning did not hold true for the 11–12 year old age sample on which the effects were tested. There is also evidence that increased media richness can decrease learning because of the increased cognitive overhead (Acha, 2009).

Hennessy and colleagues (2006) carried out case studies to examine the different ways in which multimedia was used within secondary science classrooms. They found that over-structuring of tasks and curriculum constraints led to students not achieving the full value of the activity. This has clear implications for the benefits of students’ studying at home in a more independent manner and being able to gain the full potential of the interactive media – it is important to balance structure with freedom for experimentation. Rodrigues (2007) identifies a number of factors that influence learner engagement with science simulations, including distraction and vividness, the logic and instructions presented, and relevant prior knowledge.

There is some evidence (e.g., Wang & Reeves, 2006) that use of certain multimedia environments can be motivational. However, the design of the particular environment will be of particular importance, and in this case a great deal of care was taken to balance four motivational factors of challenge, fantasy, curiosity and control. There is also evidence (Sim et al, 2006) that multimedia usability and the fun of using the software are not correlated to learning from using it. Dunlap and colleagues (2007) argue that interaction is essential for engaging students in the learning process and is critical in the effectiveness of online learning (this can refer to interaction as well as online interaction with another person). They argue that the typical method classifying machine interaction by different interface elements (e.g. rollovers, hotspots) fails to address the issue of learner engagement and meaningful cognitive processing.

### 3.3 Learner diversity

This section considers the impact that using interactive multimedia revision sites could have on a diverse set of learners, in particular examining whether they can be used to support less able learners and whether any gender differences exist in usage. Again, however, the research evidence pertaining to the impact of rich online media for a variety of learners is sparse, and there is a clear need for further empirical research in this area.

Technologies and online resources can help overcome learning difficulties in three specific ways: by providing a platform for training or rehearsal; through the use of assistive technologies; and by using technologies to make learning possible where it was not possible before (Abbot, 2007). The BBC Bitesize materials are most relevant in this context in that they provide an environment to support learning through interactivity, in particular immediate feedback so students can test themselves and see their own progress, provision of alternate visualisation and explorative learning environments, and in addition support students' attention and motivation.

While rich media has the power to engage and offer opportunities to certain types of learners, there may be issues associated with accessibility for certain types of learner, particularly those with disabilities. Sloan and colleagues (2006) suggest a holistic approach to accessibility in multimedia, saying that a range of limitations should be considered, including those that are attitudinal, practical, managerial or technical. While there is evidence that multimedia interactivity can support and engage less able learners, there is also evidence that there are still class-based inequalities, and it has been estimated that there are
still around 30% of school pupils without home access to a computer (Smith and colleagues, 2008). The picture in other countries is similar. The UK Government has recently set up a Home Access Task Force to address issue of access (Becta, 2008) but this may still not address underlying inequalities such as support or attitudes (Selwyn & Facer, 2007). Aslanidou and Menexes (2008), in a study undertaken in Greece of the Internet use of 12–18 year olds, found evidence that Internet usage was an indicator of geographic location (rural and urban areas) and social stratification (with children in more rural areas and lower socio-economic classes seeing it as a tool with which to have fun rather than a work tool). Lee (2008) argues that while Internet access has the power to affect class boundaries, there are still imbalances in terms of levels of access, support and training and types of usage, and any impact is likely to be short-lived and not significantly impact on social mobility in the future. Online learning sites such as BBC bitesize were identified as key contact points for young people not in education, employment or training and described as an example of ‘what works’ for that group because “you can read a little, practice a little, learn about whatever you want” (Citizens Online and National Centre for Social Research, 2008).

In terms of online learning making a difference to users of different genders, Osbourne (2007) found that there was more of a differential between boys and girls (with boys preferring e-learning), it also had more of an impact on pupils who were eligible for free school meals and those for whom English was a second language. There is also evidence that boys spend more time playing computer games than girls (e.g. Kent & Facer, 2004), but also that these gaming communities can be developed to support group and literacy skills, particularly for disengaged adolescent males (Steinkuehler & King, 2009).

4. Recommendations for future work

While some evidence exists as to the different ways in which children use online learning resources and interactive multimedia web sites, the literature review carried out here shows that research is somewhat limited in certain areas, particularly regarding evidence on the comparative benefits of different online teaching methods. Many of the results of these types of studies are of limited use because of the lack of valid control groups and the problems of learner choice and self-selection. There is clearly a lack of genuine evidence regarding the effects of multimedia and interactivity on learning.

The research evidence regarding learning benefits – real rather than perceived by students – of interactive multimedia is extremely narrow, mainly looking at single instances of multimedia resources used in particular disciplines and age groups over short time periods. Again the evidence of impact of these types of learning materials on different types of learner, such as studies carried out with large diverse user populations, using a wide variety of learning materials, over long periods of time, is limited. Another issue highlighted by this review is that research in this area tends to be either qualitative or quantitative, rather than using a mixed methodology, so in a sense offers only half of the picture.

The first recommendation for further research is:

- A large-scale mixed-methods investigation into the learning and motivational effects of interactive multimedia on different types of learner.

An area of growing application to learning, which is relevant here in terms of future directions for research, is the fast rise in utilisation of Web 2.0 technologies for learning, entertainment and socialisation. Chowchat and colleagues (2008) have identified the “wide-ranging implications for curriculum and pedagogy of Web 2.0 technologies, and the behaviours of young people who are incorporating them into their lives” (p6) as being one of the key themes that emerge from their analysis of trends of digital technologies in education. This
has been influenced by trends such as the rise in virtual learning, curriculum innovation and new pedagogic approaches, personalisation, the concept of ‘perpetual beta’ and the changing IT skills of learners. With the emergence of web 2.0 technologies, Siemens and Tittenberger (2009) describes six affordances of emerging technologies: access; presence; expression; creation; interaction; aggregation, while Luckin and colleagues (2008) describe a number of different types of web 2.0 user: readers, gamers, file-sharers, communicators, librarians, entertainers, mixers, newscasters, writers, artists, bricoleurs, media producers, animators, designers, programmers. However, they argue that most young people engage in digital consumption rather than production. Kiili (2006) provides evidence that students (in this case primary school) showed better recall when they were provided with the opportunity to create their own images rather than reading about or pre-selecting those of others. From this notion he describes a model of participatory multimedia learning in which the learner is facilitated to produce parts of the learning materials themselves.

The second recommendation for further research is:

- A developmental investigation into the potential of integration and exploitation of elements of the web 2.0 philosophy (e.g. collaboration, sharing, production) into the design of online learning resources.

Based on these reflections, a further research study, taking place over a minimum of two years, is recommended that examines two key areas: the real pedagogic benefits of online interactive multimedia for a diverse learner population; and the potential of elements of the web 2.0 ethos for development of online revision and support sites.

Suggestions for ways in which these two recommendations for future research could be carried out are as follows:

1. A large-scale mixed-methods investigation into the learning and motivational effects of interactive multimedia on different types of learner.
   - Large scale experimental evaluations to compare different types of learning materials usage (e.g. multimedia vs traditional, different degrees for interactivity) with different types of learner.
   - Online survey of learners to review current practices in formal and informal settings.
   - In-depth interviews (face-to-face and online) with learners, teachers and parents to examine current practice and use.
   - Data collection on technology use in informal settings using video diaries and camera-phones.
   - Expert analysis of a sample of interactive multimedia web resources in terms of learning design and usability.
   - Analysis of user interaction in online community discussion forums.

2. A developmental investigation into the potential of integration and exploitation of elements of the web 2.0 philosophy (e.g. collaboration, sharing, production) into the design of online learning resources.
   - Ideas-generating focus groups with young people and other stakeholders, adopting a participatory design approach.
   - Initial prototype development (paper or wire frame) and user testing.
   - Development of recommendations for online learning design encompassing web 2.0 principles.
References


Appendix 1: Keywords and queries used

The following keywords were used as the basis for the search strategy:

**Age range:** key stage 3, key stage 4, school children, young people, secondary, GCSE

**Purpose of resource:** revision, support

**Nature of resource:** interactive, multimedia, rich media

**Mode of delivery:** e-learning, e-resources, online learning, online resources, web-based learning

**Evidence sought:** achievement, attainment, effect, impact, practice, usage, use

**Other:** BBC bitesize, ability, community, diversity, gender, ethnicity, disability, free school meals, learning difficulties, social class

The following queries formed the core for the search:

“BBC bitesize” OR “interactive online revision”

(“multimedia” OR “rich media”) AND (“revision” OR “support”)

(support OR revision) AND online AND learning AND (impact OR effect OR use) AND school

online AND revision AND (interact* OR multimedia OR rich media) AND (child* OR school)

(interact* OR multimedia OR “rich media”) AND (revision OR support) AND (achievement OR attainment OR effect OR impact OR practice OR usage OR use)

(impact OR effect) AND (“online learning” OR e-learning) AND (ability OR community OR diversity OR gender OR ethnicity OR disability OR “free school meals” OR “social class” OR “learning difficulties”)

(“key stage 3” OR “key stage 4” OR “school children” OR “young people” OR “secondary” OR “GCSE”) AND (“revision” OR “support”) AND (“interactive” OR “multimedia” OR “rich media” OR “e-learning” OR “e-resources” OR “online learning” OR “online resources” OR “web-based learning”) AND (“achievement” OR “attainment” OR “effect” OR “impact” OR “practice” OR “usage” OR “use”)

(support OR revision) AND (interactive OR multimedia OR “rich media”) AND (impact OR effect OR use) AND school

(“key stage 3” OR “key stage 4” OR “school children” OR “young people” OR “secondary” OR “GCSE”) AND (“e-learning” OR “e-resources” OR “online learning” OR “online resources” OR “web-based learning”) AND (“achievement” OR “attainment” OR “effect” OR “impact” OR “practice” OR “usage” OR “use”)


Appendix 2: Databases, web sites and journals used

Abstract databases:

- ASSIA: Applied Social Sciences Index and Abstracts (CSA Illumina)
- Australian Education Index (Dialog DataStar)
- British Education Index (Dialog DataStar)
- Computer and Information Systems Abstracts (CSA Illumina)
- Educational Research Abstracts Online
- ERIC (CSA Illumina / Dialog DataStar)
- Social Sciences Citation Index (Web of Knowledge)

Full-text databases:

- ACM Digital Library
- Cambridge Journals
- EdITLib Digital Library for Information Technology and Education (AACE)
- Emerald
- IEEE Xplore
- Informaworld
- Ingenta Connect
- MetaPress
- SAGE Full-text Journal Service
- ScienceDirect
- SpringerLink
- Teacher Reference Centre (EBSCO Host Research Databases)
- Wiley InterScience

Other services:

- BUBL Education (bubl.ac.uk/Link/e/educationlinks.htm)
- Directory of Open Access Journals (www.doaj.org/)
- Education-line (www.leeds.ac.uk/bei/)
- Google Scholar (scholar.google.co.uk)

Journals:

- ALT-J (Informaworld)
- British Educational Research Journal (Informaworld)
- British Journal of Educational Technology (Wiley Interscience)
- Computers & Education (Sciencedirect)
- Computers in the schools (Informaworld)
- Distance Education (Informaworld)
- E-Journal of Instructional Science and Technology (http://www.usq.edu.au/e-JIST/)
- E-Learning (http://www.wwwords.co.uk/elea/)
- Educational Media International (Informaworld)
- Educational Technology Research and Development (SpringerLink)
- Educational Technology Review (http://www.aace.org/pubs/aacej/)
- Electronic Journal of E-Learning (http://www.ejel.org/)
- European Journal of Open, Distance and E-learning (http://www.eurodl.org/)
- Information, Communication and Society (Informaworld)
- Interactive Learning Environments (Informaworld)
- Interactive Technology and Smart Education (Emerald)
- International Journal of Emerging Technologies in Learning (http://www.online-journals.org/i-jet)
- Journal of Computer Assisted Learning (Wiley Interscience)
- Journal of Educational Technology and Society (http://www.ifets.info/)
- Learning, Media and Technology (Informaworld)
- Open Learning (Informaworld)
- Technology, Pedagogy and Education (Informaworld)
- The Internet and Higher Education (ScienceDirect)

Web sites:

- BBC (www.bbc.co.uk)
- Becta (www.becta.org.uk)
- CERUK (www.ceruk.ac.uk)
- DCFS (www.dcsf.gov.uk)
- DENI (www.deni.gov.uk)
- E-learning alliance (www.elearningalliance.org)
- The elearning network (http://www.elearningnetwork.org/)
- European Commission (cordis.europa.eu/home_en.html)
- European SchoolNet (www.eun.org/portal/index.htm)
- Futurelab (www.futurelab.org.uk)
- The Guardian (education.guardian.co.uk/elearning/)
- The Innovation Unit (www.innovation-unit.co.uk)
- JISC e-learning focus (www.elearning.ac.uk/)
- LTS (www.ltscotland.org.uk)
- NAACE (www.naace.org)
- NFER (www.nfer.ac.uk)
- QCA (www.qca.org.uk)
- Schoolnet Global (www.schoolnetglobal.com)
- TDA (www.tda.gov.uk)
- Teacher Training Resource Bank (www.ttrb.ac.uk)
- The TES (www.tes.co.uk)
- UFI (www.ufi.com/home/default.asp)
- UNESCO (www.unesco.org)
- Uniservity (www.uniservity.com)