

**Deep learning with technology in 14- to 19-year-old
learners - Final report**

Sally Barnes, Sue Timmis, Sarah Eagle, Ingvill Rasmussen,
Paul Howard-Jones, Graduate School of Education, University
of Bristol

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Introduction

This report presents outcomes from the University of Bristol project on '14 -19 deep learning' funded by Becta from October 2008 to April 2009.

The focus of this project has been the following inquiry: "What knowledge and skills do learners need in order to be effective deep learners now and in the future?"

Our aim was therefore to investigate the relationship between ICT and deep learning in authentic, practical settings (in a school and a further education college), looking holistically at: the context in which learning takes place, the relationship between the practitioner and the group, the design of the learning and the use of ICT tools, organizational issues, and the relationship between learning and use of ICT in and out of school or college settings.

In addition to the empirical study, we hosted an invited workshop to present the studies from the Bristol and Warwick teams and investigate key questions which emerged during discussion with an invited audience of national and international experts drawn from the research, practice and policymaking communities. The outcomes of these discussions were then intended to inform and develop our findings and conclusions.

What do we mean by deep learning?

The term 'deep learning' was first conceptualised by Marton and Säljö (1979). They identified qualitative differences in approaches to what students learned and how they approached a task. They found two different conceptions of learning, namely a reproductive conception – which gives rise to a surface approach where the learner is intent on simply understanding the content and coping with the task – and a deeper level of processing where learners are engaged in meaning-making and identifying the significance of what they are studying. The dichotomy between 'deep' and 'surface' is important to preserve because the 'surface' notion often results in misunderstanding. There is a need to translate educational policy into classroom settings, and the term 'deep learning' is being promulgated in educational institutions without clarification. This can only cause continuing confusion amongst institutional leaders and practitioners.

Methods

The empirical study was carried out in two educational institutions: a further education college and a secondary school located in the northeast of Bristol. We

worked with five different subject disciplines where a range of technologies was being used by the practitioners and/or the students. The groups included in the study were:

Further education college

- Engineering First, studying mathematics for engineering – aged 16-17 (whole class teaching and individual worksheets using scientific calculators)
- A2 level Law students – Year 13, aged 17-18 (whole class and group work)
- BTEC Media students – Year 12, aged 16-17 (project-based group work)

Secondary school

- Graphics Products – Year 10, aged 14-15 (whole class and small group work)
- Science – Year 10, aged 14-15 (whole class)

We used a mixed methods approach to gather information from learners over time about their use of technologies in and out of formal educational settings. We observed one class session for each of the five subjects. Each practitioner was interviewed after the observation and the questions focused on: how they thought their use of technology supported the learning tasks of the lesson, their own views of how technology might enhance learning, and what they understood as the concept of 'deep learning'.

Learners were invited to keep an iDiary for 24 or 48 hours (depending on when we were next scheduled to visit them). In the iDiary they were asked to note down their use of any kind of technology, the time of day they were using it, the purpose of it and any other information they wished to share with us. On our return visit to the class, we interviewed the students who completed the iDiaries in a focus group setting.

Findings

There were three key themes which emerged from the empirical work:

- Subject culture is one of the main drivers for how students use technology. There is some evidence for features of deep learning in different subject cultures.
- The issue of emerging adult identity is very much connected to how young people select and use different technologies.
- The ways in which technology bridges the formal and informal learning contexts – and their implications for deep learning – are complex and require further study.

iDiaries and use of technologies

Table 1 illustrates that within the five subject areas a total of 23 students made entries to their iDiaries and participated in the focus group interviews. The students varied in the number of entries they made in their iDiaries.

	Number of Students	Number of iDiary entries
FE College		
Law	4	39
Media	5	28
Engineering	7	48
Secondary School		
Science	3	27
Graphic Design	4	43
Total	23	185

Table 1: Number of students and use of technology as reported in the iDiaries

A clear distinction was made in the coding so that any activity that had a link to learning or working was coded in those fields. Social uses of technology referred to social-only uses. Table 2 shows that young people reported participating in social-only activities through their use of technology about 2/3 of the time as compared to the 1/3 reported for any activities related to educational work.

Overall frequency of reported use of technology		
	Number of entries	
Family	6	3%
Personal	5	3%
Social	116	63%
Study	51	28%
Work	7	4%
Total	185	100%

Table 2: Frequency of reported technology use from the iDiaries

In Table 3 the percentage (rounded up) of reported instances for social activities is similar for the students in the further college and the secondary school students. It is perhaps not surprising that there are more reported instances of study-related use of technology by the college students.

Reported uses of technology by educational institution				
	School		College	
Family	4	5%	2	2%
Personal	1	1%	4	4%
Social	49	65%	67	61%
Study	17	23%	34	31%
Work	4	5%	3	3%
Total	75		110	

Table 3: iDiary reported use of technology by educational institution

Students were asked to detail which activities they carried out through computer use. Two further college students reported using the virtual learning environment (VLE) and one carried out activities for a work experience placement. However, both word processing (N=14) and looking things up (N=13) could bridge the formal educational and the informal social lives of these young people. One key area is the prevalent use of social networking sites (N=18).

Mobile phones were used in this study for phoning and texting. We anticipated that young people would use phones to discuss assignments or project work as well as for social purposes.

Subject culture

One of the areas we have focused on is subject culture and the associated ways of working in different subject areas. The issue of subject culture is extremely relevant to the use of technologies and deep learning because the working practices in different subjects may encourage or discourage different modes of learning.

In previous research (cf. the ESRC Interactive Education project) it was very evident that different subject disciplines used various types of technology for very diverse purposes. It became evident that in the further education college, students used technology quite differently in law, media and engineering, and there were significant differences in the ways in which science and graphic design students were using technology in the secondary school.

Further education college

Media

Media is a vocational course which requires young people to work collaboratively on extended projects with two or three other students. One of the findings which emerged was that once students had acquired the necessary technical skills to work with film, etc., they could then use more advanced specialist applications, equipment and tools to create movies. Students are learning to use a range of technology to carry out production work.

Interviewer: What do you think is the role of technological tools in supporting your students?

Practitioner: On a typical production project that students do here, like the one you have seen today, they have a research element. A lot of them use the internet for that. The project briefs are on the computer – on the group’s folder, a shared folder. They can access handouts and briefs and things like that... They also use Word and Excel to create their production documents; they need to do paperwork, so they are learning to use that as well. And they use the internet to research other elements of their production like how to get to the location, so they use Google maps. They can use creative tools like Photoshop for their projects as well. Some of them wanted to make some nice, snazzy credits for their film, so they were going to put some stuff in Photoshop, then put it onto Final Cut Pro and maybe animate it a bit. They use Final Cut Pro for editing their work, and then there is all the kit that they use to actually shoot their video as well. (Media lecturer, further education college)

The students also commented on their use of technology on their course:

Interviewer: How about the technology on the course you are on, how does it help you learn?

Student: You are looking at a wider range of technology. It is not like, like using an iPod or using a laptop; it is like you have got all of these different things for editing your movies, and stuff like that. It is just advancing everything that we are going to be using, in the near future as well. (Media student, female)

In the student focus group, one of the female students described a typical evening at home:

Student: "...I have got a programme that is kind of like Photoshop but is a bit more simpler. I just take a random photo, and like, merge it, and make my own little thing, like, I like to edit, like animate it, drawings as well." (Media student, female)

Only one media interviewee remarked on completing an assignment at home:

Student: "I checked YouTube, Facebook, spent two hours on my assignment and watched a film. I was on MSN at the same time as doing my assignment, just chatting to people about random stuff. Then I went on the X-box, watched TV and went to bed." (Media student, male)

However, it is apparent that although the practitioners might expect students to do some work outside college time, they also believe that it is the students' decision about where and when to work.

Interviewer: How much of that do they do in their own time?

Practitioner: In this particular lesson, they have nine hours delivery a week of this. They are expected to work on the project in their own time...it all depends on how fast they go. I don't monitor how much they do in their own time and in class. The first two or three weeks they are sat in here in class, and then they start to disperse. It is hard for me to say. (Media teacher, further college)

Interviewer: It is up to them; they have control over that?

Practitioner: Yes, they do.

Law

In contrast to the vocationally-based media students, the law students are studying for an A-level. Their days are segmented into regular 50-minute lessons for different subjects. In a typical law lesson, students are asked to apply cases to various aspects of the law. What was evident in our conversations with the law students was that they all mentioned homework and completing assignments at home in the evening.

In the focus group interview with the law students, we asked them how they use computers in an evening. One student talked about how he multitasks between homework and maintaining conversations with friends using a variety of sites.

Student: ...a bit of everything: Facebook, most of my mates are on Facebook. MSN. The same friends, but with MSN it is immediate conversation but with Facebook it is [asynchronous]. Researching homework, doing homework on the computer. I would use [the VLE], go through [the VLE] to find the information that I need, I did that last night for history. Usually every piece of homework goes up on [the VLE]. (Law student, male)

Another student replied, remarking on how email is used to communicate with teachers:

Student: As for homework, I finished off an essay question for psychology. My teacher sent the question through email, I sent it through email, and he confirmed that he had got it. He sent revision booklets by email; I printed them out and then did revision. (Law student, female)

Engineering

The engineering group was a mixed-ability group attending a compulsory mathematics unit. The practitioner uses a whole class method, initially presenting the formulae and techniques that the students need to acquire for the upcoming exams and then setting work for the class to complete. She always has scientific calculators, pens and paper available. Most of the mathematics work can be carried out with scientific calculators, therefore using computers to support learning during these lessons is not usual.

In the science (see later) and engineering lessons, the practitioner-led class activities allowed for ongoing interactions between practitioners and learners to question the content and procedures used. The practitioner used the Smartboard to display the work and concepts to be covered; she then handed out worksheets for the students to complete. All students were very much on task, and though they worked individually they did help each other when asked. All were writing out the results for each step of the process and then the final result for each question on the worksheet.

The practitioner did not believe that students accessed course materials outside of class.

Interviewer: With the Smartboard, is all the work you did on it today saved? Do the students have access to it?

Practitioner: They have access to a VLE, and I will put a reference to the websites. They are quite good at using it – they are ahead of my construction colleagues, but

engineering has it set up and running. On some of the higher level courses interactive tests are available. (Maths practitioner, further education college)

Interviewer: Do they use laptops?

Practitioner: No, they have lessons in the IT rooms and so they have access to those resources. We can...if it was a problem we could borrow a set of laptops.

Connected to the use of resources is the question of whether teachers are seen as a resource and whether there are clear pointers on where to get help when needed.

Interviewer: Do you have any indication at all from things they say or do that they are making use of resources you offer, such as websites?

Practitioner: I think they do use websites quite a lot; they probably have not thought of using them so much on the mathematical side...a bit like the mathematics assignments. They only write them, they don't seem to consider typing them, and I think rightly so, because the students I teach for other organisations waste a lot of time trying to type up mathematical work, when they could have written it in half the time ...

One aspect of deep learning is the ability to use strategies and techniques gained in one situation and apply them in another; the practitioner does not think that her students can do this; she suggests that experience gained over time is critical for learners to be able to transfer skills.

Practitioner: If you compare students or some of the adult students coming in to do these courses, they are much more able to estimate and work out what kind of answer might be right.

Interviewer: So they [current students] are not applying it?

Practitioner: Yes, they are following a process and not evaluating the result. We say to them 'do the calculation both ways round to check your answer', but because they want one process to follow they do not want to think about how else they could reach their answer.

At several points during the class the practitioner and students made reference to a computer-based unit of work which the students study. We asked about synergies between the two units and whether this could be an area where students must apply and transfer knowledge gained in other settings.

Interviewer: Do they [the students] bring up material in your lessons which they have covered in others?

Practitioner: Sometimes they bring it up and say they didn't really understand it and ask me to extend it. He is doing it as part of a package with the materials and

electronics in terms of the theory behind it, and he hasn't necessarily got the time to do the maths of it.

Secondary school

In the secondary school, subject cultures are also very much in evidence; however, their impact on the students is less obvious. The organisation of subjects and teachers suggests that the culture related to a discipline is more a product of the teachers rather than what and how the students are learning. The school is in the process of implementing many technology-rich schemes; recently it adopted a laptop scheme where the laptops link to the school's shared workspace, and more teachers are beginning to upload materials. They will also be implementing a VLE this year. Some of the science students reported using laptops to link to the school's shared workspace and access the online version of the science textbook. In both science and graphic products, some students were using their own laptops and others were sharing laptops or school computers.

Science

The science teacher incorporates a range of technology to support her teaching, and she used a variety of other techniques to engage her students. For example, at one point she had a group of students behave like positive or negative electrons as a role play exercise, and this made quite an impact. In one of our first questions, we asked the teacher about the kinds of technologies she tends to use in her teaching:

Interviewer: Was your lesson typical?

Teacher: Yes, I often use short video clips, animations, and interactive websites. Yesterday I had taken screen shots of an interactive thing, which was a bit of a mistake because the interactive element was there but I had removed it, and this made it a bit of a problem. It is also an issue that the kids have to sign up to use some of the interactive websites, which causes an obstacle. I tend not to use the whiteboard as an interactive screen for the young people because it can cause disruption – I use it on my laptop, so they shout out the answers and I do the interacting. (Science teacher, secondary school)

We also asked her about how she might encourage her students to gain a deeper understanding of things:

Interviewer: How do you see what you and your students link up to give them deeper understanding? Are there activities that encourage it?

Teacher: Yes, they have to take responsibility and control over their own learning. It's difficult for a teacher – they are not used to it, they are used to spoon feeding – we are now trying to signpost them. Open activities prepare them for coursework, and without these they can struggle.

She goes on with examples of how she encourages deep learning amongst her students:

Teacher: I see this as an example of deeper learning because they have taken the information, seen examples and had to interpret it. It is difficult to do. They get anxious because the onus is on them to do the work, rather than the teacher.

Graphic Design

This is a very hands-on class of 17 mixed-ability students. The teacher outlined the task for the day, which was to carry out research on one of the following: Bauhaus, Charles Rennie Mackintosh, Art Nouveau, Victor Horta and others. In groups of two or three, students then searched for information on the internet and were asked to create three-minute presentations in Word.

The students were asked to download information to specific folders, which they seemed able to do. Some were asked to put information on flash drives, which they also managed fairly easily.

The teacher was looking forward to using the new VLE, and said that it “will make a big difference to staff and students – provided the staff pick it up.”

In the student focus group interview we asked specific questions about how they carried out the task, and were a little surprised at how open one boy was about his use of cut and paste to complete the task:

Interviewer: We would like to ask about the lesson where you were looking at a design movement and had to do some research. What do you think you learned?

Student 1: It was kind of hard because if you typed in a name on Google, then just went on Wikipedia, then you would copy a load of stuff onto PowerPoint, cut and paste, and then do the presentation and then [the teacher] would start asking you questions and you were like, “I don’t really know to be honest.” (Graphics Product student, male)

Interviewer: OK, so it was easy to find stuff but you didn’t necessarily understand what it was. Is that what you are saying? What about by the end of the lesson, did you understand what Art Nouveau was?

Student 1: It was an art group or something creative.

Student 2: Yes, it was a movement, and the main people were Charles Rennie Mackintosh... (Graphics Product student, female)

Another focus of the interview was to better understand how students collaborated and the kinds of discussions they would have.

Interviewer: How did you find that? Did you discuss working together?

Student 1: It was pretty easy, like, because you just let him do the work.

Interviewer: You just let them do the work? That is honest of you.

Student 1: Well he was on my laptop, so I just thought I would just let him do the work, just sit there.

The students carried out the task and some saw it more as a procedural activity than an introduction to new content.

Section summary

There are clear differences in the subject cultures we observed. There was a real distinction between the vocational-oriented media and engineering courses and the academically-oriented law and science courses. Teachers on the vocational courses seemed to work as a team. Therefore the students expected joined-up input from the different but related units of work. The use of three-hour blocks within the media programme allowed considerable opportunities for students and staff to meet and follow up on different aspects of project work. This type of joined-up work allows learners to use deep learning actions of reflection, application and potentially to transform their learning.

In more academic subjects, such as law, applying deep learning principles is problematic given the short class session times and the way teachers work in subject teams. For example, the law teacher works within a team but only within the law department. The students studying law do so for only part of their curriculum. Therefore, for the other courses they were taking (English, maths, etc.) they were encountering teachers and cultures which were different. This suggests that, whereas the media and engineering students were supported in extending their learning beyond a specific subject, the law students had to find the links between subjects for themselves.

The subject cultures all suggest that disciplines have very different student expectations, goals and practices. These may be related to the academic nature of some disciplines over others. There would also appear to be an age-related difference in the approach which students take to the subject matter and to learning in general. However, it should be noted that the students in the further education college were all over 16 and may have reached a level of maturity – having chosen to continue studying in either vocational or academic disciplines – which those students in the secondary school have not. Differences may also be related to the institutional structures which frame the learning experiences.

Deep learning and identity

Intuitively it makes sense to think that the choices young people make about which technological tool to use, for which purposes and with whom may say quite a lot about their own sense of self. We considered the question of how young people's use of technology contributes to the development of their personal identities.

In his review of the literature from neuroscience which may pertain to deep learning, Paul Howard-Jones writes:

“Neuro-imaging techniques have revealed enhanced activity in the brain's reward system amongst teenagers, prompting the suggestion (Ernst et al. 2005) that heightened risk-taking in adolescence may be due to unequal competition between this increased activity in the reward system and top-down control from prefrontal cortex, a region of the brain known to be still developing during adolescence (Blakemore 2008). However, risk-taking (and, in a pilot study, reward activity) has been shown to increase in the presence of peers, demonstrating the high dependence of such mechanisms on social context (Steinberg 2008). (Howard-Jones 2009:6)”

This sensitivity to being observed by others may be linked to notions of adolescence as a special time for identity formation and expression. Sandra Weber and Claudia Mitchell describe identity as:

“an evolving active construction that constantly sheds bits and adds bits, changing through dialectical interactions with the digital and non-digital world, involving physical, psychological, social and cultural agents. Identities... are constructed in action, using whatever cultural and life material is at hand. (Weber and Mitchell 2008: 43)”

Digital technologies lend themselves well as a source of material and means of display of this constant process of active construction and reconstruction. Consider as an example the mobile phone, for which, certainly for young people, the choice of brand and model may say a lot about what kind of person you are or want to be, as does the customisation of the handset, visual interface and ringtone. More than this, mobile phones enable their users to dip in and out of contact with one another, independent of location. Similarly, the web now offers multiple sites for the production of personal virtual spaces, exhibiting a public persona which again is assembled from cultural and life material: photographs, favourite colours, songs, quotations, and so on.

It is considered by some that technology use of this nature is conducive to helping learners develop an identity as a certain type of learner. Simms (2006) describes a deep learner as an articulate, autonomous but collaborative learner, with high meta-cognitive control and the generic skills of learning, which suggests that deep learners have developed a certain kind of learner identity.

David Buckingham argues that there is a correlation between the use of digital media (such as games, internet, online chat and instant messaging) and the development of identity as a learner:

“In learning with and through these media, young people are also learning how to learn. They are developing particular orientations toward information, particular methods of acquiring new knowledge and skills, and a sense of their own identities as learners. They are likely to experience a strong sense of their own autonomy, and of their right to make their own choices and to follow their own paths—however illusory this may ultimately be. In these domains, they are learning primarily by means of discovery, experimentation, and play, rather than by following external instructions and directions. (Buckingham 2008:17)”

There are two suggestions here: first that digital technologies lend themselves well to the work of exploring and experimenting with social identity, and second that they lend themselves well to a certain kind of learning through discovery, experimentation and play. It is consistent with the concept of deep learning that identifying as a learner should be in relation to one’s own personal life as well as in relation to subject knowledge and skills. However, many more questions than answers arise from this that require further research. Are we justified in assuming that young people are developing identities as learners through their own personal activities with technologies? And, if this is the case, does young people’s developing understanding of themselves as learners come to fruition in the institutional (school or college) context as well as in the personal and out-of-school contexts?

Throughout our analyses of the iDiaries and the focus interviews with young people, it is very clear that these adolescents stay in touch with each other throughout the day and night. Interestingly, at home these young people are still connected to their friends through their use of phones, MSN and social networking sites. All groups reported carrying out some activities related to their studying as well as social activities in the iDiaries.

	Study-related	Social	Total
FE College			
Law	23	14	37
Media	11	36	47
Engineering	6	20	26
Secondary School			
Science	13	13	26
Graphic Design	21	30	42

Table 4: The Frequency of reported study-related or social activities by subject

There are many instances when homework or study-related activities are completed while students are multi-tasking using social networking sites, phones, etc. For students at the further education college, it is possible that they regulate their multi-tasking activities depending on the timing and nature of the assignments they are completing.

Interviewer: What have you been doing on the internet?

Student 1: Bebo, Facebook, and the Bristol Rovers website, practically every day ...I usually do a bit of homework on MS Word and then I would have an instant messenger package up at the same time, and Bebo and Facebook up at the same time. (Graphics Product student, male)

Student 2: I text all of the time. (Law student, female)

Student 3: I can do it at the same time as doing other things, so I can do it at the same time as using the computer. (Law student, female)

Student 4: I could not live without my phone; I probably spend about five hours a day on my mobile. I use a talk unlimited package, cannot go to sleep without my phone. (Media student, female)

Interviewer: Who talks to you on the phone when you are going to sleep?

Student 4: The same people that have the problems I do!

Although we can see that they were using technologies extensively in their own time, it is not clear whether or how the young people and practitioners we have observed and interviewed were able to harness the potential of technologies to explore, create

and develop identities as learners. There are indications from our data that this does not happen as a matter of course.

Continuation of iDiary discussion with secondary school graphic products students about cutting and pasting information in a lesson involving research about a design movement:

Interviewer: We would like to ask about your lesson where you were looking at a design movement and you had to do some research. What do you think you learned about?

Student 1: It was kind of hard because if you typed in a name on Google, then just went on Wikipedia, then you would copy a load of stuff onto PowerPoint, cut and paste, and then you do the presentation and then (the teacher) would start asking you questions and you were like, I don't really know to be honest (Graphics Product student, male)

Interviewer: So when you cut and paste, do you not read it?

Student 2: Yes. (Graphics Product student, female)

Student 1: Not really.

Student 3: No, you just scan through it .

Interviewer: So how do you know it is the right thing?

Student 1: 'Cause you can just see like Art Nouveau, it just tells you, but to be honest you just scan through it quickly, you don't really look at it. (Graphics Product student, male)

Interviewer: So you look at keywords and think that would be alright. Do you all do that when you cut and paste?

Student 3: Yes, I think most people do that.

Student 2: The person I was working with, she was reading it.

We might suppose that through his visits to a football club's website, 'Student 1' is accumulating knowledge about the history and current activity of a local football team, contributing to the development of an identity for himself as a footballer or football supporter. In contrast to this, his use of the web in response to a task given by the teacher is at a superficial level; he does not share the teacher's implicit assumption that preparation of the PowerPoint presentation requires reading, considering and understanding the content that he has gleaned from the web.

In our interviews with practitioners, we heard several descriptions of how students experienced difficulty in self-directed work, both in the use of traditional material and

in the use of the web and other digital media for research. In the following extract from an interview with a secondary school science teacher, the teacher describes students' difficulties when she first introduces the kinds of lessons she describes as student-centred, and which involve group work and social skills:

Interviewer: How do you see what you and your students link up to give them deeper understanding? Are there activities that encourage it?

Teacher: ... Year 9 students did some research - they studied weathering of rocks and environmental chemistry, acid rain and so on. We used an Update activity. We talked about the Titan cave in Derbyshire and watched a news broadcast on it. I gave them an information sheet from the Update on chemical reactions and asked them to use it in groups to present their own news broadcasting. I see this as an example of deeper learning because they have taken the information, seen examples, had to interpret it. It is difficult to do. They get anxious because the onus is on them to do the work, rather than the teacher. (Science teacher, secondary school)

Again, while for this age group discovery, experimentation and play may characterise young people's learning about themselves and others – and may characterise their use of digital technologies in pursuit of their social goals – this teacher's description suggests that students do not bring this kind of learning to bear in the school context. If young people had been developing learning skills through their personal use of technologies, and were able to harness them in the school setting, they might be especially useful in alleviating anxieties which this teacher reports are characteristic of young people's early experiences with coursework. This difficulty is associated with a shift from a form of assessment which concentrates on getting facts and skills straight, and which Ference Marton and Roger Säljö describe as 'shallow' learning (Marton and Säljö 1976), to coursework, arguably a form of learning which reaches for comprehensive understanding and cherishes intrinsic motivation. (Perkins, 2009: 198)

The pattern we have seen for young people and their teachers in secondary school is also visible in further education. Lecturers at the further education college also pointed to the facility of some web tools which can be used for research. Although students might be familiar with using the web for research, it could not be taken for granted that young people could produce the standards and quality of research expected:

Interviewer: So in terms of their use of ICT, I mean you are giving me the impression that they are not particularly active in using the internet or a range of ICT tools outside of college.

Law Lecturer: I think they are, but not necessarily for educational purposes. It is generally quite difficult to get the students to do things like research and for it to be of a reasonable standard as opposed to Wikipedia, you know...which is slightly

alarming in the sense that many of them are off to university and thinking that research is in fact Wikipedia, and you know... (Law Lecturer, further education college)

Interviewer: And so, that is a very wide range of tools, and you are encouraging them to use as many of them as you can.

Media Lecturer: Particularly the internet the students start to rely on, and they tend to dismiss other areas which we would like to encourage them to use, such as resources in the learning resource centre, the books and journals we have in there. Sometimes it is so easy to go to Wikipedia, but we have specialist publications upstairs which they could be referring to. The concept for them of looking in an index, for example, and looking for information in another way, sometimes is daunting for them. (Media Lecturer, further education college)

In the light of this, Buckingham's statement that "they are learning primarily by means of discovery, experimentation, and play, rather than by following external instructions and directions" (Buckingham, 2008:17) can be read as a warning that where students develop an identity as learners whose preferred method of learning *is* discovery, experimentation and play, interventions into the way that young people carry out their learning need to be carefully considered.

The facilitation of identities in relation to professional practice

The Literature Review produced by the Warwick University team includes in its description of deep learning 'interactions with a variety of others,' particularly those with experience of working in relevant sectors or contexts, and Simms (2006) mentions 'enriched educational opportunities'. Technology has the potential to bridge the gap between academic study and the reality of the outside world. In trying to elucidate the extent to which this had been enabled, we questioned what experiences and contact with others had led to young people choosing to do A-level law. Had technology enabled young people to develop their understanding of what it meant to study law and the ways in which law is applied? The resources which young people quoted were word of mouth, televised news and information sheets.

Interviewer: Why did you choose to do Law A-level?

Student 1: I never thought about going into a career. I heard it was a good subject and just chose it as an option. I am glad that I chose it; I have enjoyed it and want to do it at university. (Law student, male)

Student 2: I have wanted to do law since I was in secondary school. It wasn't a subject there. I think perhaps I found out about it through watching the news – there are so many cases mentioned. There is an induction day with lots of information sheets on what you might do and the law one appealed to me. (Law student, female)

The Law lecturer describes the results of arrangements that his college makes to engage his students in real life experiences of law:

Law Lecturer: Generally the trips, the students always respond incredibly well. We went to the prison recently, and they responded well to that, to contextualising what we do, and we obviously go on trips to the courts as well, and again those are things from which students come back and you know, certainly that is a hot topic for debate for weeks afterwards.

It is interesting that engagement is encouraged through visits rather than through using technology. In the secondary school we visited, the web was being used as a tool to help young people set up a variety of work placements:

Student 1: I went to see if I have emails from my work experience people, Plan for Life, a work experience week coming up and we are meant to choose what we want, from the website. (Graphics Products student, female)

Interviewer: Helping you decide what you want to do for your work experience?

Student 1: So I am waiting to see if I get an email back.

Interviewer: Anyone else?

Student 2: Work experience, WEX online, you have to go on My Plan for Life and you have to go on that and other things to find out what placements you have got and stuff. (Graphics Products student, male)

Interviewer: Tell us a bit more?

Student 2: You go on My Applications, and you, then you have to search for the job type you like, or if you know what the job is, you just type the employer's name in and stuff, and you say 'apply for application', and the WEX online person that runs it in the school sends it to the job person, and if the job person accepts it, you get it back, and they say "oh yeah we have accepted your application, so you can come and do work experience with us".

Interviewer: You never meet them face to face?

Student 2: No, unless the WEX online person emails you back and says they want you to come in for an interview or they want an interview over the phone or application form or something.

Student 3: Yeah, I have to go for an interview. (Graphics Products student, female)

On the basis of the students' descriptions, it seems that the website was modelled on software which is used for job searches by jobseekers, rather than enabling young people to get a window into workplaces and to think about how they see

themselves in relation to them. We may in future see the development of this kind of opportunity for young people modelled on social networking sites.

Section summary

Young people make use of the potential of digital technologies in their personal and out-of-school activities, some of which may be considered to be discovery, exploration and play associated with the construction and reconstruction of personal identities and the display of this identity 'work'. We did not find evidence that young people were using skills and knowledge gained from their own explorations with and through digital technologies. If these learners were showing signs of deep learning, we would have expected strong evidence in their ability to evaluate and transform material from the internet rather than simply cut and paste. It may be the case that young people can and do carry out these activities but they may feel that it is in their interest to maintain a distinction or boundary between uses of the same tools for purposes connected with their own personal lives and for those connected with the formal institutions of school and college.

Bridging the divide? Young people's expectations and the learning goals

Technology can be exciting. Beyond the flicker of the screen, which is inherently attention-grabbing, there is evidence of the flow and engagement that technology provides. Considerable work exists investigating how the flow and motivation that are seen in the use of games can be harnessed in educational settings (see for example Gee 2003; Ellis, Heppell, Kirriemuir, Krotoski and McFarlane, 2006; Sandford, Ulcisak, Facer and Rudd, 2006).

The perception that technology in educational settings is not used as effectively as technology for gaming, entertainment, communication and socialising is reflected in our discussion with the Law lecturer at the further education college. He spoke of students' expectations of technology in terms of attention span, format, presentation, and excitement, as if they were outcomes of the ways that young people had been using technology in informal settings. He feels that if technology is to support his students in engaging with his subject, then it has to take account of their expectations that it will be entertaining and interesting:

Law lecturer: It's difficult, to produce, that kind of electronic stimulus which they like, which is short and punchy.

The relationship he is tracing between motivation and certain features of technology might perhaps be seen as an explanation for the high usage of the multiple-choice tool on the college VLE. This was designed for law students to test and develop their memory for legal cases:

Law lecturer: ...a self assessment test, you know, there were games in there and stuff which you could run, and repeat, and check your score, and make sure it was

getting better ... They had definitions down the left hand side and down the right hand side and the case would come in and you would have to drag it to the right definition and it was timed.

The tool was indeed well used:

Law lecturer: They had been doing all this stuff on [the VLE], and [the VLE] activity for law was the second highest in the college, next to sport, and we have only got a tiny little cohort which meant that my students were on it a lot, you know, they were engaged in it.

He went on to explain that, although the students made good use of the tool, it did not foster the kind of learning that he believes should be encouraged if his students are to engage effectively in learning this subject. The skills he wishes to see them develop centre on the ability to argue and critique:

Law lecturer: ...in giving all of the cases it loses structure and doesn't really demonstrate that they have the ability to be able to answer the question, and actually the results then can suffer, which is why it is quite difficult to think of a way of interacting with the technology which allows them to discover those higher analytical skills which are necessary in law to get beyond a D and without those analytical skills, I, you know, the whole parrot fashion thing doesn't work in Year Two ... but when you say I want you to step back and really consider the implications of this case, how did it develop the law, it's well... It won't help my students necessarily to develop the analytical skills that come from debate and discussion.

This teacher echoes an observation made by Lauren Resnick and colleagues: "the goals of education now include the ability to engage in the extensive cognitive world independently, whereas the world outside of school is substantially less supportive of school-based learning" (Resnick, Lesgold and Hall, 2005:78)

Institutional structures, motivation and engagement, deep and surface approaches to learning

A further focus of our work has been on three overlapping themes: institutional structures are related to young people's motivation and engagement to learn, and these are both related to deep and surface approaches to learning.

Many educational institutions run classes in short (50-minute) sessions. This was the case for all the students we worked with except for the vocational media students in the further education college. The site where the vocational media course was located had programmes that ran in different sequences of time, so the media course was time-tabled into three-hour blocks instead. This allowed for a very different flow of activities; for example, it facilitated shifting between more theoretical and more practice-based work, and longer session lengths allowed for reflection time.

Interviewer: Do you have strategies and techniques which correspond with the idea of deep learning?

Practitioner: They evaluate every project they do. We have sessions where students set their own targets, go back and note down what they have done, reflect on how well it went, what went wrong, even if something couldn't be achieved, why that was and what they would do next time. We try to encourage students to work those things out for themselves, to have conversations which encourage that kind of thinking. (Media practitioner, further education college)

In our data there are many examples of how different practitioners use the 50-minute block as a way to channel the thinking of student groups. In the law class, the practitioner regularly uses a time-based activity to force and encourage his students to work quickly and to focus on the activity. Students respond to questions asked about the law in relation to the cases with which they are working. He uses a whiteboard exercise to help the students focus, and there is a large timer on the board to keep everyone moving to schedule. As our interview with the law teacher illustrates, he quite deliberately uses time to concentrate his students' thinking:

Interviewer: I was interested in your use of the timer actually. I thought that was quite an interesting device. Why do you think you do that?

Practitioner: If you say to the student, "I'd like you to do the following task," and they see that it is three pages long, it will take them a week, but if you say "you have got ten minutes", and remind them that they have ten minutes, then they will do it. And the exam is timed. So every time I teach, it's "we will do this to twenty minutes, you will have three minutes to do this" and because they do that they know constantly that they are under a bit of pressure. And if not, when you observe other lessons, you can see where people don't have a firm structure, things just drift. (Law teacher, further education college)

The vocational media course seems to foster many of the characteristics of deep learning. Is it related to the reflective practices which can be fostered through collaborative group work, or is time the critical factor which allows for productive reflections to occur?

Bridging the formal and informal contexts: Multi-tasking

As noted above young people stay in touch with each other throughout the day and at night. They also are very adept at multi-tasking and using technologies in ways to allow them to stay in touch as well as carry on with other activities.

It is not clear how educational institutions could harness these abilities to multi-task and the richness of the communications taking place between young people on social networking sites.

Student: I usually do a bit of homework on MS Word and then I would have an instant messenger package up at the same time, and Bebo and Facebook up at the same time.

Several media students discussed the process of completing assignments:

Interviewer: Did any of you use [computers] to do work related to college?

Many voices: Yes.

Student 1: I was finishing my assignment, it was a PowerPoint presentation and I got pictures from the internet. (Media student, male)

Student 2: Yes, I was on MSN at the same time. And the Gameboy at the same time. If I have to finish an assignment for the next day then I just do that one thing. (Media student, male)

The law students also use technology to organise themselves:

Interviewer: [How do you use] mobile phones?

Student: We have been texting and ringing about choices about university, what the entry grades are, for support really, it's stressful. We can't concentrate on our studies; we need to get this out of the way. We have to prioritise each other. (Law student, female)

Three students: I use it [mobile phone] to organise myself. Sometimes it is relevant to school work; we would put a deadline or reminder to be at a certain place at a certain time. We use it for alarms for getting up in the morning. (Law students, two female, one male)

In the same interview we heard about how students have to juggle access to computers at home and how this impacts on the way they work:

Interviewer: And computers [how are you using them]?

Student: Facebook, but not as much as I used to. My stepdad has priority over the computer, which is kept upstairs in his study. Now and again I go upstairs. Otherwise I try to manage with my text books and other resources first. If I struggle I go upstairs and see what I can find or I go upstairs and print the revision booklet off (Law student, female)

Students in the secondary school reported sending assignments to their teacher via email. In this extract, a boy from the science class speaks about his general use of computers for school:

Interviewer: You had to do some English? Was that writing?

Student: English, I had to type out some coursework from my books onto my computer so I could send it to my teacher. I send it using Hotmail and my teacher has Hotmail too. (Science student, male)

Findings summary

The empirical study provides an extremely rich and detailed snapshot of young people's use of technology in and outside of their study experiences. As we have seen, technology and the expectation of using technology varies by subject culture. The emerging adult identities also affect how young people use technology and bring together their learning and social activities. This small-scale study provides a clear picture of the efforts of practitioners and students to integrate technology for learning. What is readily apparent is that the richness of these young people's technology use far exceeds the opportunities presented to them within educational establishments.

Conclusions and recommendations

In this project, we set out to examine the ways in which ICT might support a deeper approach to learning within the 14-19 age group. We looked for examples of where ICT was enhancing the learning experiences of young people in study situations in both further education and school settings.

Our findings suggest that there is no blueprint that can be applied to guarantee that learning is deep or that ICT can necessarily facilitate learning due to the complexity of learning contexts. In this short study, our empirical work could only present a snapshot over a period of a few days; what is really required in order to identify evidence of deep learning is in-depth, longitudinal classroom observation and engagement with young people's informal practices over time. We have found examples of the range of factors and conditions that need to be present or demonstrated in clear and holistic examples of good practice. These include:

- engagement and participation in the subject discourse and practices
- sufficient time to engage in the task and in the subject discourse
- a high level of control over task, time, and ways of working
- appropriate level of maturation for the requirements of the task
- relationship and engagement with peers and others, including tutors
- relationship between personal identity and the subject discourse and practices
- easily navigable communication and tasks which bridge the formal and informal, including bridging the school/college setting and the home setting.

The social dimensions of learning are very important for this age group, as the areas of the brain associated with social behaviour are still developing and the brain does not process interactions automatically. Core attributes associated with an independent learner, such as meta-cognitive approaches and critical thinking, involve a level of maturity that might not always be present in younger learners.

Furthermore, we suggest that collaboration is contingent on being able to take a different perspective, and there is good evidence from neuroscience to suggest that this social task is very challenging. We would therefore suggest that the social uses of technology outside of the study setting are very important aspects of learning which can assist with this maturation, as well as with the development of the social self and independent learning skills. This is also closely linked to the development of identity.

Finally, we would also suggest that different kinds of learning approaches are needed to meet different requirements, and therefore the notion that all learning needs to be 'deep' to be of value can and should be challenged.

Appendix: The invited seminar

In this section, we report the key points discussed from the international seminar that was held as part of the Bristol project. The seminar was developed in order to synthesise results of the empirical findings with themes emerging from the literature through a seminar workshop with key academics, practitioners and policymakers. The intention was to present an early draft of the Warwick literature review and data, and exemplar cases from the field work, to stimulate debate and discussion amongst participants and to test and develop the outcomes. This was partly motivated by the need to involve all stakeholders early in the project. It was also motivated by the recognition that the notion of deep learning – and potential role of ICT to mediate such learning – is an exploratory area which would benefit greatly from the expertise of a wide group of experts.

Key points for discussion

How can ICT support deep learning?

One of the main points made during the day was to emphasise that ICT cannot and should not be treated as a single, amorphous form and that different environments and different forms of ICT have different potential uses. ICT has the potential to undermine learning just as much as it does to transform and enable it. There is a huge panoply of different tools and forms that need to be unpacked – so being more specific is helpful in this regard.

In the afternoon discussion sessions, one of the teachers described deep learning as “a reflective process which allows a student to apply what they have learned independently. The learner needs to transform it, extend it, so the ICT must support that”. This was extended to focus on ‘context-specific practices to support ICT’. The two discussion groups spent time examining specific examples of ICT designs or implementations and how they might be thought to engage learners at a deeper level.

The issues of identity and control came up in the discussions in several places. It was suggested that ICT allows young people to hang onto a number of identities that schooling used to make them put on one side while learning or working, and this might help young people to overcome failure and struggling with their work. Furthermore, it was mentioned that one of the difficulties is that young people are not in control all of the time – not in control of their lives. When they get home, they want to control their own lives a bit more, and arguably online social interactions allow them to be at the centre of their own social worlds and to manage this. It is again an important aspect of maturity and development.

It was also pointed out that the idea of students taking control is deeply embedded in the 14-19 framework and the changes that are taking place about personalisation, giving those children some degree of control of what is happening to them between ages 14 and 19. But it was also important that students should understand what they

should be learning, and how the technology is supposed to be supporting that learning.

Seminar summary

There was general dissatisfaction with term 'deep learning', and attendees commented that there was no clear definition. Definitions offered over the course of the day reflect the general emphasis of seminar attendees on learning as understood in terms of a participation metaphor in preference to an acquisition metaphor (Sfard, 1998), as illustrated by the following comments:

Attendee 1: "a reflective process which allows a student to apply what they have learned independently. The learner needs to transform it, extend it"

Attendee 2: "being introduced and enabled to participate in specialised discourses"

Consistent with this approach, there was a focus on the relationship between the social environment and the design of learning environments and tasks. This emphasis on the social was reinforced with contributions based on neuroscience research which suggest that social uses of ICT, communication and identity-building can be seen as potentially important aspects of developing capacities for deeper engagement with learning. These points were underscored by descriptions of teaching strategies and research on learning with games. Within a vocational course, mathematical tasks were made meaningful in relation to their practical application. In a computer game environment, feedback and discussion with more knowledgeable others were considered to contribute to engagement and to learning.

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