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Narrowing the gap: Literature review
2009

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An exploration of the ways technology can support approaches to narrowing the gap for underachieving and low-achieving learners in secondary schools

Introduction

The research programme, which underpins this brief literature review, addresses how technology can be used to meet the challenge of equipping young people with the skills to participate in learning throughout their lives. The central focus is identifying the pedagogic practice that can effectively support students identified as low-achieving or underachieving learners. Centrally, we ask how technology can be used to help reduce the attainment gap between underachieving and low-achieving learners and other students in secondary schools.

Context

The context of this research relates to the UK Government's agenda for social mobility. It has the dual aims of:

- ensuring there are better jobs for each successive generation
- making sure that there are fairer chances, so that everyone has the opportunity to access those jobs in line with their potential (Performance and Innovation Unit 2001).

The social mobility policy is symbiotic with the Government's economic strategy, which states that economic and social well-being can only result from unlocking "the talents of every child and young person from their earliest years, and supporting adults right through their working lives." (Cabinet Office, 2009, no page)

While such aims are generally accepted across the political and social spectrum, the achievement of these aims has proved problematic. Differential levels of achievement between various student groups—defined by factors such as social class, gender and ethnicity—have been a cause of concern in the UK for many years (Fastenau *et al.* 2008). At the heart of the problem lies a worrying and persistent cohort of children at secondary school level who can be classified as either low achievers or underachievers. As many as 26,000 students (5%) leave school without any GCSEs and over 75,000 (17%) of 15-year-olds have low levels of literacy, despite ostensibly going through eleven years of compulsory education (Educational Working Group, 2006).

The presence of this cohort has resulted in a raft of policies emerging from the Children's Plan and the Skills Agenda asking local authorities and schools to renew their efforts for these children (Jephcote and Abbott 2005). The White Paper, *14-19 Education and Skills* (DfES 2005) specifically recognised the need to transform education. It demonstrated that student disaffection, truancy and low standards of schooling and achievement were linked with crime and low or absent activity in the workplace. This paper was a rallying call to transform secondary and post-

compulsory education—although the focus in the UK, which is mirrored in the US, has been on the development of the basic skills of such ‘at risk’ children. In the UK, the problem is crystallised in a cohort of 16- to 18-year-olds that are not in education, employment or training (NEET). This group contains a preponderance of individuals who have failed to acquire even the basic skills that will allow them to participate as full citizens in tomorrow’s world. The focus on basic-skills-for-all, while understandable, does lead to the criticism that young people are being prepared for those commodity jobs (Shaffer and Gee 2007) which in essence can be done more cheaply and as efficiently in the developing world. The survival of first world countries, however, is dependent on innovation linked to a highly skilled workforce (deep learning). Therefore, a second set of underachievers—able students who are not fulfilling their potential—provide a different but equally important challenge to the educational system.

Low achievement and underachievement

What does it mean to achieve?

In its widest sense, attainment extends across a range of activities including traditional academic fields of knowledge. However, it also might include sporting or artistic prowess. Few of us are polymaths, capable of excelling in many fields. Rather, as Sternberg (2000) has shown, the refinement of skills in one area often leads to the neglect of skills in another domain, because expertise requires practice. For example, time spent learning to ‘bend it like Beckham’ may be time spent not perfecting mathematical competence. So, it is generally acknowledged that achievement comes in many guises. Indeed, “laypersons have long recognised a distinction between academic intelligence (book smarts) and practical intelligence (street smarts or common sense).” There are many ways to achieve and they do not always relate to academic performance.

However, in the current context of narrowing the gap, the assumption is that achievement relates to academic performance such as the National Curriculum assessments. Such attainment may be influenced by factors such as children’s basic intellectual and emotional capacities, their socio-cultural backgrounds and the quality of the education environment (Gathercole and Pickering 2000). Consequently, it is vital to consider the learner’s experience in context. Such attainments are also structured by the limited set of knowledge and skills targeted by these assessments and it is therefore important to consider how much achievement goes unreported.

Defining low achievement and underachievement

While it was acknowledged in the 1990s that there was some disparity between definitions of low achievement and underachievement (Plewis 1991), generically the terms were used to imply a negative relationship between perceived expectations and actual attainment. More recently, the complexity of these concepts has been recognised, resulting in something of a consensus as to both the definition and

measurement of underachievement (Smith 2003 and 2007). Both concepts can have a breadth of meaning, ranging from achieving no qualifications to failing to keep up with the grades of peers (Prince's Trust). Underachievement is therefore a matter of degree.

A fundamental issue in understanding low achievement and underachievement is to consider whether they are related to the individual's ability or to some group norm. The gap between an individual's achievement and his or her own ability best describes underachievement, while an individual's lack of achievement compared to a group norm more appositely describes low achievement. The former is a relatively fixed relationship, while the latter varies with the composition of the comparison group.

Specifically, in regards to academic achievement, an individual will be viewed as underachieving if:

- the grade achieved is below the predicted obtainable grade. That is, "achievement falling below what would be forecast from our most informed and accurate prediction, based on a team of predictor variables." (Thorndike 1963)
- there is a large discrepancy between expected achievement (as measured by standardised achievement test scores or cognitive intellectual ability assessment) and actual achievement (as measured by class grades and teacher evaluations) (Reis and McCoach 2000).
- the discrepancy between expected and actual achievement is not a direct result of a diagnosed learning disability (Reis and McCoach 2000).

In this case, the term 'underachievement' is essentially a cognitive-psychological definition.

In contrast, low achievement encompasses the idea of a young person who, at each significant stage of education, has not reached the expected levels set by the government (Prince's Trust).

For those seeking to narrow the educational gap, the emphasis will be on those students failing to achieve basic skills, as is the case in this project. However, it should be recognised that gifted underachievers—who are not perceived as fitting the usual 'at risk' classification—should also be a concern. Often highly intelligent, they are turned off by school or are struggling to stay involved during adolescence. They are often frustrated and unhappy, and their failure to perform at a level commensurate to their ability is a serious loss of potential adult productivity.

In summary

- Low achievement is referenced to the group norm.

- Underachievers are not confined to children who perform badly – some of the brightest are nevertheless underachievers.
- Underachievers are those who are not reaching their full potential.

Factors affecting low achievement and underachievement

There are many explanations for low achievement and underachievement (Reis and McCoach 2000; Bruner and Caron 1959; Pierce 1960; Mandel and Sander 1988; Lindsay and Muijis 2006; Educational Working Group 2006). Factors that impact on learners include: personal/individual differences, overt behaviours, socioeconomic and cultural factors, and the educational environment.

Personal/Individual differences

- **Ability:** while this is a major factor, less able students *should* perform below group norms or benchmarks. If they achieve above a group norm, then they are overachieving. To categorise underachievers as 'just not smart enough', that is as low achievers, is disingenuous. Almost every underachiever can do better, given the right kind of help, even though they may not reach educational benchmarks.
- **Cognitive deficits:** such as poor Working Memory (Gathercole and Pickering 2000) or Central Executive function¹ (Rueda *et al.* 2005)
- **Poor internal locus of control:** this leads to a tendency to blame others for failure. Learners doubt their own ability to gain the resources needed to be successful (Walls and Little 2005).
- **Gender:** girls outperform boys in national tests until middle to late adolescence. For example, girls are higher achievers than boys at GCSE level (Smith 2003). This is partly explained by different rates of maturation. There is also a general tendency to associate underachievement with boys (Jones and Myhill 2004). However, some argue that the perception that boys are higher underachievers than girls is just a myth; working-class boys are not predominantly underachievers (Smith 2003).
- **Emotional adjustment:** poor emotional adjustment can lead to underachievement. For example, those who are under stress may not be able to learn readily. Conversely, children who do not do well in school may feel ignored or out-of-place, which can lead to low self-efficacy and motivation. Also, these children may make internal attributions of failure.

¹ The Central Executive is the component seen as responsible for the selection, initiation, and termination of processing routines such as encoding, storing and retrieving information.

- **Physical factors:** this might include sight or hearing problems or physical illness, such as asthma, which can lead to time off from school.
- **Negative attitudes to school and learning:** this may promote school avoidance or disengagement.

Overt behaviours

- **Willingness to persevere:** achievement is linked to perseverance and motivation; underachievers have a tendency to give up (Reis and McCoach 2000; Borkowski and Thorpe 1991; Miller 1969; Underwood *et al.* 2008; Underwood *et al.* 2009), and they function poorly in competitive environments (Rimm 1997).
- **Reliance on external factors:** underachievers are more likely to rely on an external or extrinsic regulation system. This means that they may be less likely to receive internal satisfaction from a joy of learning (Walls and Little 2005).
- **An absence of prior attainment, particularly in basic skills:** those who underachieve at primary school often fail to catch up. The effects of early underachievement may escalate with the transition to secondary school (Perry and Weinstein 1998).
- **Maladaptive behaviours including withdrawal in class:** there are higher rates of withdrawal among underachieving boys, suggesting that this could be linked with boys' characteristics of not wanting to conform to the ideals of education (Perkins 1965). This withdrawal, in turn, can lead to a downward spiral of truancy, exclusion from school and, in the worst cases, offending behaviour.
- **Low engagement with the school and classroom environment:** this can result in poor school adjustment. It may also result in children actively engaging in school avoidance behaviours.
- **Poor peer relationships:** children who are less liked and rejected by peers tend to perform less well academically. They are also less engaged with classroom activities.
- **Attention seeking:** underachievers may engage in inappropriate behaviour to receive attention from teachers or other school personnel.
- **Resilience:** young people who are at risk can also prove to be resilient learners, able to adapt to changing circumstances in a way that traditionally successful students cannot (Claxton 1999 and Dweck 2006).

Socioeconomic and cultural factors

- **Family structure:** students who grow up in institutional care or multiple foster places, or in large families are over represented in low and underachiever groups.

- **Parenting styles:** underachievers tend to experience less responsive parenting and fewer demands in terms of academic performance (Shek and Chan 1998).
- **Student mobility:** underachievers may have a history of attending a number of schools, which may influence their ability to adjust and feel comfortable in school.
- **Low family income and parental unemployment:** the major factor that works against achievement is poverty. Children in poverty have basic survival priorities that take them away from school work. Also, those children who have had to learn self-reliance at an early age often find it difficult to adjust to school rules and procedures.
- **Level of parental education and parental involvement (particularly that of the mother):** children whose parents are involved with their learning (for instance, reading together) will have enhanced performance.
- **Street culture:** this is often a more significant cause of academic underachievement than the home environment. This is especially true for boys. Some 67 per cent of 14- to 16-year-olds report that 'laddish' behaviour is partially responsible for underachievement (Francis 1999).
- **Peer group norm and peer pressure:** where it is not appropriate to engage with classroom activities, some underachieving individuals may fear being labelled as a 'swot' and ruining their reputation with their peers (Smith 2007).
- **Bullying:** this is associated with peer pressure and can lead to self-exclusion from schools. This is particularly true for girls (Osler and Vincent 2003).
- **Ethnic background and fluency in English**

The educational environment

- **Poor or inappropriate instruction with little consideration of individual needs; poor organisation; tolerance of maladaptive behaviour:** teachers need to gear their teaching to the ways that individual students learn.
- **Incorrect assessment of the learner:** the misinterpretation of an individual's ability can negatively influence self-assessment, thus leading to further underachievement (Peterson and Colangelo 1996). Further to this, teacher expectations may lead to a negative self-fulfilling prophecy (Perry and Weinstein 1998).
- **Non-recognition of skills:** Gohm, Humphreys and Yao (1998) compared students with high mathematical skills (seen as achievers) to those with high spatial ability (seen as underachievers). The latter were less motivated in class compared to the maths group, but scored higher on business and vocational courses.
- **The students perceived relevance of the educational experience**

- **Teacher attitudes and perceptions:** teachers view underachieving boys differently to underachieving girls (Jones and Myhill 2004).
- **School ethos:** Pedersen et al. (1978) studied a group of children who were identified as at risk initially in primary school. They found that a support environment buffered the children against later risk factors.

In summary

To be academically successful at a level commensurate with their abilities, learners must engage with the learning process.

- If a child is de-motivated, although they have the capability to achieve, their attainment will be negatively affected.
- Motivation is a prerequisite to success, but must be translated into engagement and persistence.
- Many children are unprepared at home for school-based learning. This becomes a greater challenge when attending failing schools.
- External pressures, particularly peer pressure, can lead to educational alienation.
- Groups from socially disadvantaged backgrounds are most at risk.

How prevalent is the problem?

Low achievement is relatively easy to measure as it relates to performance against a set of benchmarks. The current Government Level 2 target, equivalent to at least five GCSEs at grades A*-C including English and mathematics, was achieved by 67.2 per cent of students in the best performing authority. However, the two least effective authorities recorded 29.6 per cent and 29.9 per cent pass levels. Fewer than 40 per cent of local authorities reached a threshold of 50 per cent of students meeting this Level 2 target (Gohm *et al.* 1998). In the most damaging cases, current data shows that nearly five per cent (over 26,000 students) leave school without any GCSEs. More than one in six 15-year-olds (75,000 students) have a level of literacy that is so low as to limit their job opportunities (Fastenau *et al.* 2008).

There are no simple direct measures of underachievement because this group of students includes those who reach group norms, but not their own potential. It also includes those who are failing to benefit from the educational system. A series of indirect measures is therefore used to assess the size of the problem. Much of the data is collated at a national and a local level for statutory bodies; others are direct measures taken from students in school.

Statutory measures include: persistent absenteeism, student mobility, receipt of free school meals, levels of English fluency and ethnic background.

- **Persistent Absenteeism:** In 2007-08, the overall level of truancy in English schools rose to 1.01 per cent (DCSF 2009). The secondary school

truancy level was 1.49 per cent. This was a small decline from the previous year, but remains a significant increase over the figures recorded a decade ago. There were around a quarter of a million persistent absentees (PAs), learners typically absent for more than 20 per cent of the school year. This is again a reduction from the previous year. It is these PAs who are the most at risk. Slightly more girls than boys are recorded as PAs with Year 11 being the peak year. Social disadvantage, as measured by free school meals and membership of certain ethnic groups, all contribute to increased levels of persistent absenteeism.

- **Student mobility:** examining the number of schools an individual has attended during their school career is a useful indicator because of potential difficulties associated with settling into a new school environment.
- **Receipt of free school meals:** free school meals have been used as an indicator of socioeconomic status and parental income, both of which have been associated with underachievement (Smith 2003).
- **Level of English fluency and the ethnic background of the student.**

More affective measures include attitudes towards school, motivation and attribution of success, peer relationships and peer group status.

- **Attitudes towards school:** there is some evidence that students' sense of belonging has an impact on motivation and therefore, indirectly, on effort (Goodenow 1993). Schools in which learners feel they belong tend to be well-organised, satisfying and encourage group cohesion (Fraser and Walberg 1991). Attitudes towards school can be used as an indirect measure of performance. A study of Year 9 learners' affective response to schools found more positive attitudes among girls, those learners with higher academic self-concepts, and those with more positive perceptions of teaching. They point out that "affective aspects of learning may have longer-term impact on the willingness and enthusiasm of young people to participate in learning" (Ireson and Hallam 2005, p. 309). Underwood *et al.* (2007, 2008) found that such positive attitudes had a measurable effect on academic performance.
- **Motivation/attribution of success:** motivation can be linked to the approach to learning that an individual is endorsing. For example, learners might be adopting a deep approach, a surface approach or a strategic approach. Deep learning correlates with, but is not identical to, intrinsic motivation, while surface learning has a similar overlap with extrinsic motivation. It should be noted that learners may use either approaches depending on factors such as the task type, although they may have a preference for one over the other. The third approach, termed strategic, can be summarised as a very well-organised surface approach in which the motivation is linked to extrinsic rewards such as good marks. Smith (2007) reports that underachievers tend to be highly selective in where they channel their energies, with some attempt being made at identifying

‘useful’ subjects and putting more effort into those studies. In this sense, they are strategic learners. Motivation can be assessed using a global measure of self-concept such as the self-description II questionnaire (Marsh 1990). Alternatively, self-reports of academic confidence could also be used (McCarthy 2000).

- **Peer relationships/peer group status:** children with low-quality peer relationships and who have experienced poor peer acceptance are more likely to drop out of school (Parker 1987), while those who are actively rejected by their peers are more likely to leave school before the end of compulsory education (Zettergren 2003). Mapping of peer group status is sensitive, but if handled carefully it does yield information about learners who are at risk.
- **Parental involvement:** Smith (2007) reports that parental involvement is associated with achievement. Parental involvement here is assessed as the level of interest in the child’s school work and the extent to which parents ask about homework. Such involvement is reflected in parental engagement with the school, such as attendance at parents’ evenings, membership of parent-teacher associations or acting as a school governor.

Types of low achievement and underachievement

There are diverse categorisations of low achievers and underachievers. If children are not confident in school they will develop protective defence mechanisms. Rimm (1997) identifies prototypical underachievers: the dependent conformist and the dependent non-conformist, the dominant conformist and the dominant non-conformist.

Dependent conformists attempt to manipulate adults. When children complain, are overly negative or ask for help when they don’t really need it, they are being overly dependent. If they insist on wielding power without thought for others, they are too dominant. Rimm argues that either of these two behaviours will result in a measure of underachievement. Importantly, Rimm points out that with maturation, children tend to move categories with a rise in dominant behaviour. Her categorisation has a degree of overlap with categories devised by the Centre for Applied Motivation (2008).

The centre presents a four-fold categorisation based on personal traits or characteristics: the distant underachiever, passive underachiever, dependent underachiever and defiant underachiever.

Distant underachievers have difficulty establishing a trustful relationship with teachers and peers and therefore protect themselves by withdrawing. They can excel in technical based subjects; however, they have a low threshold for frustration, acting without consideration for the consequences. They seek immediate

gratification and don't generally understand the concept of sacrificing now in order to meet later goals.

Passive underachievers are driven by gaining approval. However, this need dominates them and their ability is clouded by fear, causing them to lose focus and not respond, or respond incorrectly. They spend long periods of time preparing for work or re-writing work, which consequently is never completed.

Dependent underachievers often show preference for activities that have no long-term value. They associate achievement with abandonment and a breakdown of relationships with peers and family. Thus, they perceive failure as positive. They like to be the centre of attention, challenging authority and blaming others or events beyond their control for their underachievement.

Defiant underachievers set personal goals, but are easily frustrated when these goals cannot be met with minimal effort. They have a false sense of independence, trying to formalise it by opposing others. Their fear of failure creates a sense of insecurity displaced into a lack of responsibility, non-completion of tasks and a failure to commit.

Rimm argues that there are many ways of overcoming underachievement. Focusing on the most intractable group, dominant non-conformist adolescents, she argues that there is a need to play to such students' strengths, while working to ameliorate their weaknesses. For example, a good reader who declines to write could be asked to read to younger pupils. In this way, the good reader has an audience for his or her strength. They might eventually be asked to write the stories that they have read, thus practising a skill that is in need of development.

How do people learn?

One key question posed by the Narrowing the Gap Programme is, "What do we need to know about the relationship between how people learn and the use of digital technologies to enable us to design, plan, prepare and construct learning environments?" Our understanding of the nature of learning is central to answering this question.

The plethora of competing learning theories, such as behaviourist, cognitivist and constructivist models, might at first sight suggest that little is known with any certainty about learning. However, that is far from the truth. If we look more closely at the raft of theories, we often find that there are significant points of overlap and agreement. For example, although Caine and Caine (1990) argue that all human learning has a biological basis leading to changes in the brain, they recognise the affective aspects of learning. They assert that meaning, and hence learning, occurs through patterning, and that emotions are critical to that patterning. The value of practice also has a biological explanation, since those neurons repeatedly firing form stronger and more numerous connections. However, this is a more subtle form of

learning than mere drill, because there is a level of selectivity as neurons have the ability to stop firing when the stimulus turns out to be unimportant. Mere drill and practice models of learning do not take this selectivity into account. Zull (2002), like Caine and Caine (1990), acknowledges the role of emotion in the learning process. Chemicals, including adrenaline, serotonin, and dopamine released during the act of learning, lead to changes in the neuronal network.

So, neuroscience confirms that practice is central to successful learning, although Zull adds that practice in a meaningful way only occurs when the student is engaged. That engagement comes when the work has meaning for the learner that transcends the need to acquire grades (Newmann and Wehlage 1993). Engagement is the bridge to more affective models of learning such as Keller's (1978, 1983) four-factor theory of learner motivation. The four factors are:

- 1 **Attention:** a student's attention has to be aroused and sustained.
- 2 **Relevance:** the given material relates to their interests and goals. If the content is perceived to be helpful in accomplishing learners' goals, then they are more likely to be motivated.
- 3 **Confidence:** students have to know that they will probably be successful before completing a given task. They have to feel somewhat confident. Success is not guaranteed and people enjoy a challenge. However, the challenge can't be too difficult.
- 4 **Satisfaction:** if the outcome of a learner's effort is consistent with their expectations and they feel relatively good about those outcomes, they will remain motivated.

For Zull and Keller the art of teaching is to find ways that make learning intrinsically rewarding.

The perception of learning as brain exercise, rather than as knowledge acquisition, is gaining currency outside of education. This follows the recognition that the brain is not immutable and that environmental influences are capable of altering brain structures. This has led both researchers and educators to question the capacity of the brain to respond to enrichment for learners of all ages. As Diamond (2001) notes, enrichment effects on the brain have consequences for behaviour. She argues that parents, educators, and policy makers can all benefit from the knowledge that they can impact on the developing brain.

Alongside general theories of learning there are also those closely associated with e-learning. Mayer and Moreno (Mayer 2001; Mayer and Moreno 2002) have applied the Dual Coding Theory from cognitive psychology (Paivio 1986) to multimodal learning in digital environments. The basic premise of the Dual Coding Theory is that cognition involves two subsystems, a verbal subsystem to process language and a non-verbal imagery subsystem to process non-linguistic information. The theory assumes that visual and auditory information is processed via different verbal and

visual systems. These can be activated independently, but are connected via dual pathways allowing more efficient coding of information. The view that there is limited capacity overlaps with Sweller's (1999 and 2006) Cognitive Load Theory. This states that a learner's attention and working memory are limited. Coupled to this model of processing, Mayer (2003) argues without controversy that learning is an active process, thus linking the cognitivist and constructivist descriptions of learning.

The third theory finding currency in the e-learning community is Flow Theory (Csikszentmihalyi 1975). Flow is described as a mental state that occurs when an individual is fully immersed in an activity. Flow experiences are intrinsically rewarding, producing intense involvement, focused attention, clarity of goals leading to a lack of self-consciousness and a feeling of full control over the activity. Athletes often describe this state of consciousness as 'being in the zone.' A state where self and task merge results in the individual being intrinsically motivated to repeat the activity now deemed to be worth doing for its own sake. Flow Theory has been widely used to explain the feeling of telepresence in virtual environments. This is the state of consciousness that gives the impression of being physically present in a mediated world (Minsky 1980; Sadowski and Stanney 2002). This theory has been extensively used to explain the lure of video games (Kiili 2006; Weibel *et al.* 2008).

We can see that learning leads to physiological changes in the brain. This provides us with new ways of monitoring learning activities. Learning requires attention and practice, but attention and practice require the emotional engagement of the learner. Engagement comes from individuals seeing an activity as relevant to themselves, but also as something that they can achieve. There are then physiological, cognitive and affective aspects to learning, and they are all important.

The way forward

A second question of the Narrowing the Gap Research Project asks "What small steps can we currently take to use technology in a more innovative way to develop synergy between formal and informal learning?"

First we must go beyond the blame game.

"When we hear stories of children or schools who are thought to be underachieving, often it is our instinct to lay the blame on the pupils themselves, their families, or the teachers, yet we seldom ask if the educational offering we're presenting to those children is out of keeping with their needs and the realities of their day-to-day lives."

Lord David Puttnam (cited in Rudd *et al.* 2009, pp 3)

We must also recognise that not all solutions to the problems of underachievement are technology-led. Ofsted (2009) has identified 12 schools as providing a quality learning experience in disadvantaged areas. These schools share the characteristics of leadership and ethos.

- In terms of leadership, they:
 - have outstanding and distributed leadership
 - have clear planning and implementation strategies
 - are constantly looking for ways to improve further
 - operate with a very high degree of internal consistency.

- In terms of ethos, they:
 - have strong values and high expectations that are applied consistently and never relaxed
 - put students first, invest in their staff and nurture their communities
 - are highly inclusive
 - provide consistently outstanding teaching, rich opportunities for learning and encouragement and support for each student
 - actively work to ameliorate the educational handicap of a non-English speaking home life.

The Pre-VENT initiative is partly funded by the European Social Fund and focuses on the thousands of disadvantaged adolescents from the Heads of the Valleys region of Wales who are in danger of dropping out of school and becoming economically inactive (Welsh Assembly 2009). The initiative works to develop each individual's affective skills—motivation, emotional intelligence and confidence—coupled with vocational training options that could provide an alternative to traditional academic learning.

The question here, however, is how can technology provide added value to these important characteristics? The potential of the technology to transform learning, as explained in the latest version of the Harnessing Technology strategy (Becta 2009), is outlined under three headings:

- Planning and management of the use of technology for learning
- Development of safe and secure learning environments
- Effective use of information to support learner progress and transition.

Roschelle *et al.* (2000) identify four key ways that technology can enhance what and how children learn by encouraging active engagement, group participation, frequent interaction and feedback, as well as connections to real-world contexts. They argue that if the technology is embedded in a broader education reform movement that includes improvements in teacher training, curriculum, student assessment, and a school's capacity for change, then technology will prove to be an even more effective learning tool.

We would propose a further benefit of technology, which is to offer a stimulating and challenging educational environment that can engage nearly all learners including those who are more resistant to traditional teaching programmes. Technology can

also be a valuable support tool in the development of deep as opposed to surface learning. The goal of any learning programme should be to provide both basic and high level skills, the latter often being associated with the concept of deep learning. According to the Higher Education Academy, “the idea that students can and do take a deep or surface approach to their learning is probably one of the most used bits of educational research as it explains how an awful lot goes wrong with the learning processes” (Houghton 2004).

Exemplar projects of effective practice from the literature

There are numerous accounts of how technology supports the learning of underachievers. Here, we present nine examples of projects that capture the range of learner needs that can be supported by technology. This is by no means an exhaustive list, but it does reflect the myriad possibilities available to educators.

1. Improving results by monitoring behaviour
2. Authentic learning
3. Using learner self-assessment
4. Practice makes perfect
5. Changing the student perceptions of the classroom
6. Just-in-time tutoring
7. Learners with English as an additional language
8. Improving Executive functions
9. Using Biofeedback to ameliorate the problem of ADHD

1. Improving results by monitoring behaviour

As any teacher will attest, the first step to effective learning is getting learners to attend school with regularity. Indeed, truancy or persistent absenteeism is a significant causal factor in academic underachievement. This case study focuses on the use of technology to monitor learner behaviour and also to encourage positive behaviours in school. Relevant to the Narrowing the Gap project is the use of the system to identify and target groups of learners for special action by the teaching staff.

An 11-16 technology college

This organisation abandoned its previous paper-driven system as it was cumbersome, not fit for purpose and encouraged negative assessments on behalf of staff. Tracking individual learner behaviour was seen as too labour intensive in all but the very extreme cases.

A new custom-built system² allows easy recording of five levels of good and bad learner behaviour. Both positive and negative Level 3 behaviours trigger notification to parents. Two-thirds of parents can be contacted by email, while the remaining third receive a system-generated letter. Learners and parents receive a weekly summary.

The system is used for general behaviour tracking and specific campaigns. For example, the school took an initiative on chewing gum with the aim of reducing the amount of gum stuck to various surfaces around the school.

The school, as with many of its peers, has focused on increasing the number of learners achieving five GCSEs. Using data from the system, two groups of learners were identified: learners currently performing below the target, but who could be encouraged to improve, and learners currently performing at the target level, but deemed to be at risk of slipping back. The teachers identified what the issues were for each individual learner and made suggestions as to how to address these issues. Each child was given a mentor and their progress was carefully monitored throughout the year.

2. Authentic learning

The need for meaningful learning to engage all learners, but particularly those who are showing limited benefits from the education system, has already been established. Here we present a brief case study of how authenticity can become part of the learning experience. The key aspects of this case study are not only that it involves authentic labour, but also that the teacher found a way of providing success for all learners. The use of technology was integral to the project in that it provided key tools and cemented the perception of real world learning in the eyes of the children.

Year 8 ICT lesson in the ICT suite

The case study involves a class of Year 8 learners from a rural middle school in the East of England. The project was to create and develop a small business. Such an activity has been repeated in many schools, but this does not undermine the importance of such work when it is carried out effectively as in this example.

Small companies of five or six learners were given the task of selling seeds as an adjunct to The Big Greenhouse Project, a science initiative at the school. Each company had a manager and a treasurer, though these roles moved around the group. Minutes were kept and a business plan was developed. The special delight of this enterprise was that the small business experience was real in that a product was

² i-behave, www.improvebehaviour.co.uk

developed and sold to customers with any profit going to the learners. Among the companies created by the learners was 'Scentsational: scented flower supplier u can trust' who claimed they were inexpensive but of the highest quality. 'Grannies Garden' on the other hand promised 'our passions for your pleasure.'

The ongoing task required learners to consider and report on production, markets, communication and accounts. During the observed lesson in the ICT suite, learners were engaged in a range of group and individual activities to move their companies along. Much of the activity was centred on marketing. Several groups were creating web pages for their companies using a multimedia authoring tool³. Others were creating animations for their promotional material using an online facility at the Digital Films website⁴. Around the suite, learners were using a variety of word processing, spreadsheet, publishing and mindmapping software. They were also using email and conducting internet searches. The groups were making progress on their own initiative and sought help when they needed it from the teacher or from their peers. They all appeared positively engaged with the project and were industrious throughout the lesson.

One notable feature of the teacher's approach was his careful tailoring of tasks to develop the individual learner in roles such as technicians or workers, for instance, in the school greenhouse. Each of the roles had a degree of skill and responsibility and provided the learners with many opportunities to succeed and to display their growing maturity.

A number of similar case studies can be found on the Network for Teaching Entrepreneurship (NFTE) trust website. This network, initiated in the US, became established in the UK in 2000 and is one of a number of initiatives to develop a more relevant curriculum for today's learners⁵.

3. Using learner self-assessments

This example shows the effectiveness of self-assessment as a method of engaging students with learning and becoming reflective practitioners.

A Year 11/12 A-level design technology class

The teacher initiated the session by guiding the students through the learning objectives, which contained a list of items that the children **MUST**, **SHOULD** and

³ The learners used Mediator, multimedia authoring software. www.matchware.com/en/products/mediator/

⁴ Learners can make a digital film at www.digitalfilms.com

⁵Network for Teaching Entrepreneurship. www.nfte.co.uk/index.php?mod=case_studies&id_cstctg_cst=2)

COULD achieve by the end of the session (a school initiative). All students also completed their own self-assessment exercise. Based on these results, the teacher selected five students who were identified (by themselves) to be weak in certain areas of the module objectives. For instance, five students were having difficulty in using HTML code in web page design. The teacher sat these students at the front of the interactive whiteboard and guided them through the tasks. The other students continued individually on their own computers, designing their web pages. Progress in the session was determined by self-assessment and students set their own targets/goals for the class. The fact that this was initiated by the students' own reflection during the self-assessment exercise shows that the teacher was accommodating individual children's needs in the session.

4. Practice makes perfect

Practice makes perfect or why it takes 10,000 hours to be a success at anything is the central theme of Gladwell's (2008) text, *Outliers: the story of success*. What is interesting about the 10,000-hour rule is that it applies to almost all human endeavour. Many before Gladwell have also argued that the difference between success and non-success is practice.

The concept of practice is the underlying principle of many serious games. A serious game is designed principally for education and training purposes. One of the earliest examples of such games was TRAY (Haywood and Wray, 1988). This was a language game designed to develop reading and spelling. It also honed the orthographic skills of adolescent boys who had been underachieving in English. Designed in a simple format, it encouraged practice of such skills in a fun environment. Straightforward in its concept, it was highly successful.

Many other such programmes designed to develop low-level skills particularly in numeracy and literacy have been made available. They form much of the educational market into the home.

5. Changing student perceptions of the classroom

A very simple example of using presentation software in lectures will suffice to illustrate how new technologies change the learning context. A range of studies (Apperson *et al.* 2006; Pippert and Moore 1999; Susskind 2005) has found that lecturers who use presentation software instead of older non-digital technologies (such as chalkboards or overhead projector slides) are rated as 'better' on a wide range of teaching dimensions by their students. This positive halo effect for technology users was seen to spill over into activities unrelated to the lecture format, such as handing back papers on time, providing helpful feedback, and assigning tasks requiring critical or creative thought. The students also held stronger academic self-efficacy beliefs when presentation software was used. Such lectures were perceived as being easier to understand. The students believed that they took more

notes and perceived those notes as being better organised and more useful for studying when multimedia presentations accompanied the lecture.

6. Just-in-time tutoring

One seemingly obvious way to aid learners who are not achieving is to offer online help at the point when the learner experiences a problem. 'Help' functions are a standard feature of interactive learning environments. Such help may take the form of hints, glossaries or linked hypertext pages that offer additional information. While there is some evidence that such help facilities foster learning if they are used effectively (Bartholomé *et al.* 2006; Renkl 2002; Schworm and Renkl 2002), other studies indicate that learners are not using such help facilities effectively (Aleven *et al.* 2003). Indeed, Aleven and Koedinger (2000) reported that learners spent very little using time such help. Learners ignored hints on how to solve a problem. Instead, they looked ahead for the answers.

Why should technology prove to be so ineffective here? Underachievers are generally surface or, at best, strategic learners who are not seeking the deeper understanding that such online help is designed to develop. Teachers can encourage such learners to use online help, but these learners do not seek it out for themselves.

7. Learners with English as an additional language

The Oregon IN TIME project is based in secondary schools and supports Hispanic migrant students (Knox and Anderson-Inman 2001). These non-English Mother Tongue students attend regular classes along with a bilingual, note-taking mentor. The mentor and student communicate using a collaborative word processing and graphics package on a wireless laptop. The student can read the real-time translation of key words by his or her mentor, allowing students to build both English and Spanish literacy skills.

Primary School in the suburbs

In the UK, we visited a school based in a largely Muslim community and with 95 per cent of pupils being non-EMT. In order to engage parents with their children's learning, the school equipped 90 Year 3 children with home computers. The majority of learners developed good ICT skills through this initiative and are now acting as prime educators for their parents. The literacy skills of the parents are being developed through children helping parents. ICT was seen as an essential catalyst in this endeavour (Twining *et al.* 2005).

8. Improving central executive functioning

A central question concerning education and brain development is whether classroom interventions can alter neural networks related to cognition in ways that generalise beyond the specific domain of instruction (Posner and Rothbart, 2000).

Posner and his colleagues argue that executive attention and effortful control are critical for success in school (Rueda *et al.*, 2005). They developed a 5-day training intervention using computerised exercises to train executive attention in children between 4 and 7 years of age. The training proved successful and had the added benefit of significant improvement in intelligence scores in the trained group compared to the control children. This finding suggests that training effects had generalised to a measure of cognitive processing that is far removed from the training exercises.

9. Using biofeedback to ameliorate the problem of ADHD

There is a large body of scientific research documenting the effectiveness of neuro-feedback for ADHD and many areas of psychological or neuro-developmental difficulty (Knox and Anderson-Inman 2001). In partnership with NASA, SmartBrain Technologies has created a number of interactive games, including a non-violent driving game. This game improves visual tracking skills, hand-eye coordination, planning, concentration, memory and patience. Orlandi and Greco (2005) tested the impact of playing this driving game on boys aged 9-11 years who had a primary diagnosis of ADHD. The results showed that the non-game playing group experienced a 47 per cent study drop-out rate from clinical support. However, the experimental group had only 6 per cent study drop out rate and showed a number of positive behaviour changes.

In summary

In line with Sir Alan Steer's *Review Of Behaviour In Schools* (DCSF 2009), this report highlights personal and group discipline, engagement, and relevance as key factors that encourage positive learner responses to education. Eight of the nine examples here show an effective use of technology to support at risk learners by engaging them, encouraging personal discipline and developing cognitive and social skills. This is outlined below.

- Discipline
 - personal discipline training (examples 8 and 9)
 - collective discipline, by monitoring learner behaviour coupled with feedback to the learner, the parent and the teacher (examples 1 and 3).
- Engagement
 - increasing motivation, investment in learning and more positive attitudes towards the learning experience (examples 3, 5 and 9)
 - skills acquisition leading to increased self-efficacy. This can facilitate more positive attitudes to learning and to school in general (examples 4, 5, 7 and 9).
- Relevance

- learners respond when they can see the learning task has personal meaning, especially if it relates to life beyond the classroom (example 2).

Contrary to expectations, the use of machine-based help systems (example 6) has not proven to be effective. This is because the majority of learners do not recognise the value of these tools. They either use these tools poorly or not at all.

Further thoughts

The advantages of learning with new technologies, particularly those supported through the internet, include the flexibility of 'anytime and anywhere' learning (Brandon, and Hollingshead 1999). Benefits also include the potential for self-paced learning and the ability to link resources in many different formats, which can accommodate different learning styles. There is also the potential to widen access to learning resources for people who might wish to learn outside the classroom, such as those in a work-based environment.

New technologies have been shown to be motivating (Cavendish *et al.* 1987). Pintrich (1999, 2000) outlines three general types of motivational beliefs:

- self-efficacy beliefs (judgements of one's capabilities to do an academic task)
- task value beliefs (beliefs about the importance of, interest in, and value of the task)
- goal orientations (whether the focus is on mastery and learning of the task, grades or extrinsic reasons for doing the task, or relative ability in relation to social comparisons with other students).

Personality factors impact on self-regulatory behaviour, but they also impact on the propensity for risk taking. Although risk can be evaluated cognitively, it evokes an emotional reaction. Cognitive and affective responses are interrelated and impact on one another, although cognitive evaluations of risk are sensitive to variables, such as the assessment of the probability of success or failure. In contrast, emotional reactions are sensitive to the vividness of associated imagery and proximity in time (Loewenstein *et al.* 2001). How individuals perceive risks of various kinds is an important influence on the choices that they make.

It is apparent to all but the most techno-romantic that merely adding technology to an educational environment is unlikely to produce the improvements in the quality and outcomes of learning that were originally anticipated. A more focused effort is required.

The association between affordances of the technologies and practices of human agents is key to understanding what works, what does not and why. One example of human agency impacting on the mode of technology used is the propensity for US schools in disadvantaged areas to use technology for more traditional memory-

based and remedial activities. Schools serving wealthier communities, on the other hand, are more likely to focus on communication and expression (Luthar *et al.* 2000; Roschelle *et al.* 2000). Lau and Lazarus (2002) suggest that teaching ICT literacy skills, specifically those related to multimedia literacy in web publishing and video production, can improve the economic prospects of at-risk youths by giving them marketable skills. Technology is a powerful tool, but we should not forget that its effects are mediated through human behaviour. Students, teachers and parents lie at the heart of a successful education system.

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