Body and mind

A report on the use of ICT in physical education (PE)

Becta
ICT Research

Contents

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Introduction

What can a sedentary discipline like ICT possibly contribute to a subject centred around action and bodily performance? Why bother to use technology at all? How do teachers answer these questions?

This report is drawn from three national qualitative studies, carried out over five years and involving over 200 skilled computer users in the UK teaching force.[1] The studies explored good practice in the use of ICT in 12 separate curriculum subjects. Research addressed the following questions:

1. How does ICT help teachers convey the central concepts of their subjects?

2. What can be learned with the aid of ICT that might not be learned as readily in any other way?

The studies found that each curriculum subject uses ICT distinctively, has singular hardware requirements and is treated differently in terms of resourcing and access.

Principal findings

At first glance, ICT appears out of synch with PE. It seems to undermine the purpose of the subject. Computers are seen as contributing to the couch-potato culture, whereas PE cultivates athletic skill. PE promotes activity, fitness and co-operation. These aims would seem to clash with those of the indoor, immobile, introspective cyber world.

PE teachers typically share this view. Those we interviewed said, for example, "PE should be about *doing* – not sitting at a computer. PE time is so limited that practical sessions are a priority." Likewise, "Every minute a child spends at a TV monitor is a minute of activity lost." Hence ICT resourcing for PE is not a high priority for the majority of PE departments or indeed for school senior management teams. Activity time is constrained and, too often, even core resources for sport are lacking.[2] As one teacher explained, "If it is a choice between spending £100 on software or on footballs, footballs win."

Yet, despite their reluctance to use technology in lessons, PE teachers seem keenly interested in ICT in principle. Software surveys carried out by the Fischer Family Trust in 2000 and 2001 attracted a strong response from PE teachers – indeed, the second highest response rate of any subject.

Comments made during the survey implied that PE teachers used computers avidly in their private lives. They were also all in favour of ICT for *their own* use outside lessons. They used desktop publishing, word processing and web clips to produce illustrated worksheets, sports day posters and achievement certificates. Asked to name and rate ICT products which, in their view, had the greatest impact on learning, they gave highest marks to products used for presentations – specifically, PowerPoint, projectors and interactive whiteboards. However, relatively few had access to these.

1 The first study, in 1998–9, involved 120 teachers who used computers innovatively in mathematics, science or geography at Key Stage 3. It was initially funded by Becta but ultimately by the DfES and several companies as well. A panel of subject experts and government education officials chose the teachers from a larger group of nominees. The second study involved 100 secondary school teachers who rated technology highly and whose pupils achieved better-than-expected results in national examinations. PE teachers were part of the group. This study was an offshoot of research carried out during 2000–1 by the Fischer Family Trust, an educational charity. Further PE-specific research was carried out in spring 2004 to examine progress and bring results up to date.

2 As reported by Ofsted, over 20 per cent of schools still lack satisfactory PE facilities, although the situation is improving. *Ofsted subject reports 2002/03: Physical education in secondary schools*, February 2004, p.2.



What they resisted was the encroachment of technology into lesson time. Few had any sense of the PE-specific potential of technology, which is unsurprising given that no New Opportunities Fund (NOF) trainer offered a PE-specific course. Survey respondents deplored the inadequacy of their NOF training, the lack of time to practise ICT skills, the dearth of computers in their work areas and (for those who considered it important) their lack of access to ICT suites.

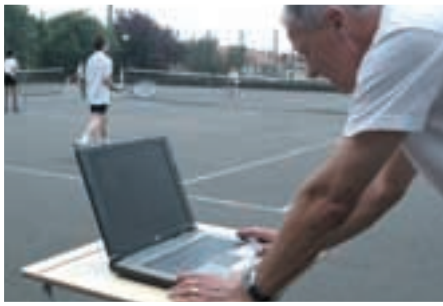
Does any of this matter? Appearances are deceptive. Teachers who perceive a clash between the two disciplines would have a point if ICT were limited to desktop computers. Below Key Stage 4, it may indeed be difficult to justify extended desk time. However, in PE as in professional sport, ICT goes well beyond using computers. It encompasses still and video cameras, visualisation software, heart rate and blood pressure monitors, electronic stopwatches, dataloggers and spreadsheets, and portable devices such as laptops and personal digital assistants (PDAs).

Schools that own such assets and use them properly are few and far between. Sports college status doesn't guarantee optimal use of ICT, nor do all technology colleges use their resources to best effect in sport or dance. Anecdotes suggest that even well equipped schools may wheel their kit out just long enough to put on a show for a journalist or Ofsted inspector and then lock it away again. Used correctly, however, some of these tools are transformational. They merge physical and intellectual activity. They alter the way in which youngsters master athletic skills and indeed revolutionise their approach to learning in general.

Teachers interviewed for this study are breaking new ground in pedagogy, developing learner-centred teaching styles and cascading these across their schools to other departments. In the process, they also bridge diverse subjects, linking, for instance, with English or science. In these rare, inspiring cases, the catalyst is usually one dedicated teacher, LEA or county adviser or local college lecturer. This report concludes by describing their tactics and the factors that foster their effectiveness.

Inspirational practice is the exception, however. The national map of excellence in use of technology within PE shows scattered bright lights against a bleak background. It doesn't help that the products with the greatest potential are very expensive, even by the standards of ICT. They derive from professional sport or the leisure industry and are well out of reach of the typical PE department.

All too often, PE departments are treated like poor relations, insufficiently valued because PE is well outside the core curriculum and doesn't figure in league tables. Their very location – at the periphery of a school or college campus – can isolate them. Too often, they are not connected to school computer networks because their structural separateness means it costs more to wire them in. In these cases, ICT, which ought to overcome or compensate for physical dispersion, compounds the problem. PE departments are excluded from the intranet that binds other departments more closely together. Many find it difficult to extract even basic hardware from beleaguered budget-holders, let alone the more costly and glamorous products best suited to their subject. Paradoxically, though, precisely because of its transformational and cross-curricular potential, the case for high-end equipment may be easier to make. The very feature of PE that relegates it to the academic sidelines – namely its focus on physical over intellectual skill –



can, in league with ICT, help the subject achieve its full potential.

Within the curriculum, PE is almost unique in emphasising movement as a medium for exploration.[3] Physical activity and skill are paramount. A child who lacks academic confidence can still, sometimes, excel in PE. Sport outside school is a passion for many young people, both as participants and fans. In an anti-achievement sub-culture, professional athletes are among the few successful people admired by youth. They are the only role models for painful hard work and persistence that many young people accept.

For all these reasons, PE offers a way in to the hearts and minds of disaffected youngsters – a hook for capturing their interest, instilling life skills and luring them subtly towards attainment in general. Planning, tactics and knowledge of fitness are part of the subject from the start, but become increasingly important at GCSE and beyond. As academic elements are added to the subject, ICT makes them palatable.

Linked with technology, PE may help reduce worrying rates of social exclusion, poor health and obesity, and could become an attractive target for both public funding and philanthropy. However, ICT must be used to enhance physical activity, not distract from it. Effective use requires systematic planning, which, in turn, in a resource-constrained environment, demands considerable initiative.

PE teachers are physically energetic by nature. They are 'doers' and this trait can underlie an enterprising drive. Their subject cultivates leadership and team-building. The teachers quoted in this report possess these skills in abundance. They are both team-players and leaders, coaching and enthusing their colleagues as well as their students. They are also reflective, as shown in the following pages.

Seeing is believing

Technology can change the nature of learning, enabling students to grasp concepts that previously eluded them. In PE, visualisation software[4] is the prime example. Even still photography is a step in the right direction. As Richard Little, Director of Sport at Eltham Green Specialist Sports College in London, notes, "PE is the only subject where students can't see their own work." A further explanation is offered by Steve Kibble, Physical Education Adviser for Devon Curriculum Services, and President of the subject association, BAALPE:[5] "PE is a very visual subject. Sixty-five per cent of what kids learn in PE, they learn through demonstrations and copying." Rob Williams, a PE teacher at The Byrchall High School in Wigan, agrees: "One only has to look at any football pitch in the country to see children trying to practise a skill in the style of a famous player they have seen on the television."[6] The visual dimension to PE is clearly recognised by students, too. As one commented, "When I saw what I was doing wrong it made me even more determined to put it right."

Any visual image can help a student improve performance, but athletic performance is fleeting by nature. How can its elements be captured for analysis? An ordinary VCR makes it possible to pause a moving image, take it forward or replay it. Visualisation software takes a revolutionary step beyond this, enabling the teacher to break a video image down into its component parts, like the separate cells of an animated cartoon.

3 See margin notes for PE, Key Stage 1, on the National Curriculum online website. [http://www.nc.uk.net]

4 There are a number of visualisation software packages on the market. Teachers interviewed for this report use either Dartfish or Kandle.

5 British Association of Advisors and Lecturers in Physical Education.

6 Rob Williams, *BPRS Project 2003/2004: An investigation to examine the effects of digital ICT on Key Stage 3 teaching and learning in physical education* (unpublished paper), p.7.

Using visualisation software, a badminton shot can be stopped in mid-flow and dragged back and forth to show the correct technique.[7] Two images can be re-sized and synchronised to match one another, then overlaid or placed side by side. A student can then compare his or her movements and timing with those of a professional. Or the student can compare previous and current performances to see improvement. Images can be reversed from left to right or vice versa, enabling a left-handed student to compare performance with a right-hander. A clock can be superimposed to reveal the time taken by, say, a golf swing and the effect on the distance travelled by the ball. Further tools can draw and calculate the angle of release in a javelin throw or the angle between knees and trunk at the height of a pike jump. Images can be saved, printed out and annotated.

Explaining the differences these features make, Caroline Skerten, PE teacher at King Alfred's Community and Sports College in Wantage, says: "They watch each other anyway but [without a camera] the action is over and done with too quickly. The software lets them slow the movement down and study it frame by frame. They can get to the very specific part they need to improve and see exactly what they've got wrong… You can lock two video images together – your student and a tennis pro from the Commonwealth Games. Comparing their own serve against a professional's makes the difference in technique very obvious."

Replay can be delayed very briefly, to let a student perform an action and then watch it on screen straight away, without rewinding, while the next student takes a turn. Each student gets immediate feedback while the camera runs and the class continues – there's no need to stop everything.

Underlining this, Steve Kibble points out that students watching each other in real life "can only see it once and then have to remember it". The software lets them capture an action *and* replay it instantly for analysis "without rewinding tapes and all the rigmarole of going from camera to screen".

A subject specialist from Her Majesty's Inspectorate (HMI) notes that teachers use visualisation software to develop students' observation and evaluation skills in depth: 'The students are able to discuss the others' skills as well as their own. Seeing themselves helps students develop their kinaesthetic awareness. It helps them *feel* what they're doing right or wrong.' Mark Colman, PE teacher at the Arnewood School in New Milton, Hampshire, observes further that, "They get a buzz from seeing themselves perform and comparing themselves to others."

The point is that students see, vividly, what they need to do to improve.[8] The performance they watch is personal, hence more compelling. The technology (not just the pairing of images, but the screen itself) puts them on a par with the athletes they wish to emulate. At the same time, it lets them see, graphically and in minute detail, where the disparities lie. The fact that feedback comes from a machine rather than a teacher makes it easier to take: it feels more neutral or objective. Students become the ultimate judges and arbiters of their own performance. They take charge of bettering themselves. They learn to self-evaluate. Steve Kibble confirms this. In a sense, he observes, the technology takes on the role of a teaching assistant, a second educative presence in the room. "It allows teachers to give kids greater autonomy – more responsibility for their own learning."

7 Example provided by Angela Finch, Head of ICT and Beacon School Co-ordinator, The Byrchall High School, Wigan.

8 "I don't think I would have realised what I was doing wrong… When you have the video or the digital camera, you can see [how] to improve yourself." Student at The Byrchall High School, Wigan, quoted in Rob Williams, *BPRS Project 2003/2004*, p.14.

Herein lies the revolution. Suddenly, as Richard Little explains, "You don't need the teacher to tell you how you look. Visualisation software creates student-based assessment. And it's ongoing. It happens not just once at the end of term, but in every lesson. Students can see it immediately. The teacher remains beside the trampoline, in coaching mode. The student completes a sequence of jumps, steps off and goes round to the laptop to see how he did or watches as his performance is projected on to the wall of the gym. The student's engagement is maintained beyond the moment of the jump itself. The teacher, having told him what to look for, asks, 'What did you see that you needed to improve?'"

A second dramatic impact of visualisation software is that its use almost forces teachers to focus in on key points. Certainly, the software facilitates this kind of discernment. The teacher becomes a film director, determining what sorts of images, from which angles, will best convey the essence of the lesson. The process sharpens the teacher's own sense of what needs to be conveyed. Bringing out key points – and teaching students to do so – is central to pedagogy. Use of cameras and visualisation software hones this skill until it becomes second nature.

Steve Kibble, who has introduced visualisation software into nine Devon schools, sees effects on pedagogy in general: "The benefits have been enormous in terms of the way teachers now teach. They're more careful in the way they set up activities and demonstrations because they're more aware of the images they want the kids to see. This comes through in lesson plans, teaching notes and worksheets. It also improves the way they give feedback." A sharp focus is possible only because the software allows it. Because their students will be able to study each stage of a movement minutely, teachers think even harder about the elements of a given skill and the best ways to impart them.

The benefit intensifies if students themselves plan the filming. A Year 10 class at Droitwich Spa High Specialist Sports College, Worcestershire, learned to operate digital camcorders to produce still photos for use in coaching younger students. One of the students reported that the project taught her "how to focus on certain things," such as specific items or people. Skill in selecting key visual points may then carry over into an ability to do the same in a verbal context. Visual learners acquire a generic learning skill that might elude them if they tried to master it verbally first.

Images need not be analysed immediately, however, and this gives rise to further choices. Teachers may ask students to catalogue video clips for later revision or to select the best clips to illustrate written work. Students might annotate clips to explain the biomechanics of a move or show how they improved a piece of choreography. They can also attach clips to their personal performance portfolios, to show their own progression. As soon as Mark Colman's Year 12 students complete their A/S exams, they devote two weeks to filming their own set-up skills in a sport of their choice. The video clips then form the basis for analytical work in their final A-level year.

Teachers use video clips themselves, to reinforce teaching points in subsequent lessons (especially on rainy days) or to jog their memories at assessment time, but imagery is not a magic wand that creates avid learners all by itself. The teaching context is critical. Use of ICT must be designed to achieve a well-considered purpose. In the trampoline example, above, the teacher conveys the intent of the lesson and the role of the image in accomplishing it. Youngsters know what to look for and are asked

what they might do to fix any flaws. The ultimate buzz comes not from the image in itself, but from its power to help them improve. Students can't self-start until they know the destination.

Rob Williams of The Byrchall High School underscores this point: "Both peer and self-assessment require guidance from the teachers to [understand] exactly what to look for or comment on… By showing the pupils images of particular skills, I, as the teacher, was able to concentrate on giving clear teaching points and detail to the pupils. The ability to slow or pause movements [enabled me] to focus on particular areas or points."[9] A student adds: "Watching Sir talk through the video was very helpful, because when I was watching another pupil do her sequence, I could look for the right things."[10]

Teachers who participated in a DfES good practice conference organised by the Fischer Family Trust in summer 2003 agreed that video-related resources raise standards only where 'teaching approaches… make self-evaluation a key element in improvement'. They recommended that departments consider appropriate pedagogy before introducing the technology.[11]

A focus group of Year 8 students at Earls High School in Halesowen, Dudley, used digital cameras, experimentally, as an evaluation and improvement tool in gymnastics, dance and athletics. At the end of the day, according to teachers, participants' practical performances were "more thoughtful, autonomous, fluent and intelligent". Their discussion skills and use of technical terminology also improved. The school attributed these good results to new schemes of work giving detailed planning guidance on when to use the cameras in lessons. This meant that pupils could perform, analyse their performance using worksheets, and then improve their performance from what they saw on playback.

Unfortunately, as reported by Ofsted, planning for the use of ICT in PE is rarely systematic.[12] Outside assistance can make a big difference. Shining exceptions to the Ofsted finding are the nine schools in Devon where county advisers Steve Kibble and Steve Cayley have worked closely with teachers to ensure that visualisation technology is used in context. Careful planning is a critical element of the use of any sort of ICT, in any subject.

Professional coaches and athletes use visualisation software much as teachers and students do. In fact, the software used in schools derives from the world of professional sport, where ICT has been an influential factor for years. Steve Kibble began using Dartfish when he realised that, "in the 2003 Winter Olympic Games, 45 of the gold medallists had used Dartfish in their training". He has helped the manufacturer adapt the product for use in schools. Kandle, successfully piloted in Hertfordshire schools, likewise had professional coaching origins. Athletes' use of such products attests to their effectiveness.[13]

Yet visualisation software is still a rarity in the school environment. Its take-up is so recent that it fails to appear on the list of teacher-rated, high-impact resources for PE published by the Fischer Family Trust in 2002.[14] Even video and digital still cameras, on their own, 'are rarely used in core provision at Key Stage 4,' according to Ofsted, and even less at Key Stage 3.[15]

Nigel Green, Head of Physical Education at Deyes High School in Sefton, gives two reasons for this lag in take-up, namely, "finance and faff".

9 Rob Williams, *BPRS Project 2003/2004*, p.16.

10 Quoted in *ibid*, p.17.

11 See *Identifying the impact of ICT – a DfES conference held at Warwick University, 30 June to 1 July 2003* on the Fischer Family Trust website. [http://www.fischertrust.org]

12 Ofsted *report: ICT in schools – the impact of government initiatives*, HMI 2196, May 2004, p.4.

13 By analogy, mobile phones originated in the military and were then adapted for the business world before eventually entering the mass market.

14 See the Fischer Family Trust website. [http://www.fischertrust.org/pe.htm]

15 Ofsted report: *ICT in schools – the impact of government initiatives*, HMI 2196, May 2004, p.6.

At the top end, visualisation software is priced for the professional sporting market. Packages with fewer features are available and perfectly effective, but the software investment is just the start. A teacher who wants students to see their own performance also needs a camera to take the shots, a computer with high processing power to run the software, a display medium to show the results, possibly a VCR or data projector (depending on how the system is set up) and all the associated wiring and storage capability. The display medium can range from the wall of the gym, to a laptop screen, to multiple televisions sited at strategic points, to an electronic whiteboard. Sports hall and playing field environments impose additional, unique requirements (see the Practicalities section below).

Then there's the extra work and the time it entails. Lesson preparation requires more thought when this technology is used, but again this is only the start. Nigel, who also serves on the executive committee of the subject association, PEAUK[16], lists the factors: "It takes a long time to get the equipment ready for a lesson and to build up the technical skills to use it effectively. You need software, hardware and, in an ideal world, someone to set it up for you."

The active nature of PE, Nigel continues, requires special precautions: "We use the technology with trampolines. The safety implications are extreme. Accidents can paralyse a student. You have to be on your guard all the time… Yet, before we can even start, at the same time as setting up four trampolines, we have to set up three televisions and video recorders."

A teacher can be a keen and competent user of ICT at home, "but once you go to a gym or sports hall, it becomes a lot more on top". It's all action in PE, quite literally. The teacher has enough to think about, without adding trailing wires and breakable, theft-prone kit to this volatile mix.

Despite all this, Nigel uses technology avidly because its effect is significant: "We see great gains in observation and analysis, as well as physical skills."

Nigel offers advice for minimising costs. For starters, it is not essential to buy the all-singing, all-dancing version of a visualisation software product. Mark Colman of Arnewood School in Hampshire, gets excellent results with the standard, as opposed to professional, Dartfish package. Nigel recommends digital still cameras as another option. Some relatively cheap models take 60-second video clips, which can be sufficient for teaching purposes. The clips, Nigel explains, can be played straight back, paused and replayed. "The cameras are easy to manipulate and less fiddly than camcorders, which have to be rewound. Images can be saved straight on to disks as thumbnail clips."

Nigel suggests, as a first step, using such a camera linked to an ordinary television with a single electrical lead between the two. "In an initial stage, that's the way forward. You get the benefits, but you're not so inconvenienced. You've got to make it easy if you want people to do it."

Resourcefulness is a common thread. Dr Gareth Stratton, Reader in Pediatric Exercise Science at Liverpool John Moores University, recommends using a £40 webcam, linked to a laptop and data projector, as yet another, relatively low-cost alternative. His students paint white rectangles on to the sports hall wall to substitute for screens.

16 Physical Education Association of the UK.



Each approach has benefits and drawbacks. Visualisation software, with associated hardware, costs the most, but permits analysis that is simply unachievable by other means. A still camera gives superior picture quality but, as Nigel Green explains, "The moving image is better for analysing how you got into a movement, through it and out."

The easiest way to make these tools affordable is to share purchasing costs with other subject departments. This entails dialogue across departments on curriculum development and planning – a good idea in any case. As shown below, software for sport is also relevant to mathematics and science. Video cameras have promising uses in English and drama and still pictures can illustrate written work in any subject. All these tools are, by rights, whole-school investments. Closer links with other departments will help PE teachers to demonstrate this.

Making every minute count

Videos can be used in changing rooms to introduce a lesson before it starts or to get players pepped up for a match. Gary Whiting, a PE teacher and Director of Football at Thornleigh Salesian Sports College in Bolton, piloted this approach for his dissertation while still a trainee teacher. He came up with the idea as a way to overcome timetable strictures.

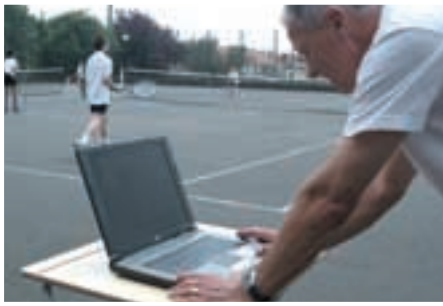
The school allotted 60 minutes for a PE lesson. Girls needed 15 minutes at the start, and again at the end, simply to get changed. "I was trying to extend the teaching opportunities in this situation. I wanted to see if pupils could take on teaching points while changing and so get more time to practise," says Gary. He discovered that they could.

For the pilot, Gary used a video showing badminton skills, emphasising the specific skill, such as the overhead clear stroke, to be taught in the forthcoming lesson. Teaching points were shown as bullets on the screen. Two television sets on tall stands were positioned at either end of the changing room. A female member of staff was posted as an observer. Two top sets of Year 9 girls took part. One group had videos in their changing room. The other did not. Moderators assessed the girls' knowledge and skills at the start and end of the eight-week unit. The two sets were similar at the outset, but far apart at the end, with the video group having learned almost twice as effectively.

Badminton was chosen for the trial because the sport receives little coverage on television. This helped limit outside factors which might have influenced the result. The videos were not required viewing, but their contents sank in nonetheless. The cleverness of the approach is that it uses an otherwise empty block of time to grab students' attention and ensure that they come to the lesson primed for action. The videos bring 'dead time' to life, cramming instruction, by stealth, into every available minute.

Fitness sensors

Fitness and health are a central part of the PE programme of study. From Key Stage 2 onwards, youngsters learn how exercise affects their bodies and contributes to their health. Although too many



schools still limit this element of study to a perfunctory discussion of the warm-up and cool-down processes, a significant minority delve more deeply, often with the help of heart rate monitors and similar digital tools. Adding spreadsheet packages, they link PE with work in science, ICT, mathematics or even basic numeracy.

The gym at Eltham Green Specialist Sports College in London is somewhat comparable to the fitness room in a leisure club, with treadmills, exercise bikes and rowing machines. When using the equipment, students can wear chest bands which measure their heartbeats and transmit the information to a display device. Other sensors are available to measure speed and strength.

Children from surrounding primary schools participate in a fitness programme which exploits these tools to the full. They have PE lessons at the college, using the exercise equipment and sensors. Then they go to an on-site city learning centre to do related work in numeracy, thinking skills and data handling.

Philip Noakes, City Learning Centre Scheme Manager, explains that the children use their own data to test hypotheses – for example, that tall people run faster than short people. In the gym, youngsters collect data on their heart rates, reaction times and lung capacity. In the learning centre, they enter the data into spreadsheets, perhaps plotting speed against height, weight and gender. Learning occurs at each stage, but notably when they discuss the resulting graphs, draw conclusions and seek explanations for their findings.

Eltham Green students design their own fitness programmes. They take baseline measurements of their speed, flexibility and strength, devise a plan to improve each of these factors, and then track their progress over time. In the process, they learn the relationship between heart rate and exercise and the impact of fitness on health. As they adhere to their programmes over time, they can trace the results for themselves. Graphs showing their improvement can be cut and pasted into essays.

At other schools, teachers report using heart rate monitors to develop students' understanding of difficult concepts such as the target heart rate in exercise. Students measure their heart rates at various stages of exercise, the length of their recovery times and so on. Using spreadsheets and graphs, they compare their own fitness levels with those of their classmates. The ease of collecting the data lets youngsters focus on the teaching points that the data reveal, while the personal nature of the statistics makes them meaningful and helps to involve youngsters in what would otherwise be dry analytical work.

Visual depiction, whether on the exercise console itself or in the form of a graph on a computer screen, helps to imprint points made verbally. The immediacy of feedback holds youngsters' attention. The adult nature of the technology flatters youngsters, thus further motivating them.

This very point can cut the other way, however. Fitness sensors, like visualisation software, were designed for professional athletes and the leisure industry. Teachers note that they don't always suit the school environment or children's physiques. "The chest bands are often too big for small frames…", "There can be problems putting on the bands in mixed classes…", "They can rub and must be washed between use," are typical comments.

Notwithstanding the sophisticated usage with young children in the City Learning Centre at Eltham Green, analytical use of data

from fitness sensors occurs primarily at GCSE and above. Even at higher levels, use of fitness monitors is relatively rare. Teachers are familiar with these devices because they use them in their private lives, for example at fitness clubs. However, most have yet to integrate them in lessons. As we have seen, they value action over theory. As one says, "It's more important for us to teach technique than to measure results."

Some teachers collect the data but then pass it on to other departments for analysis. Indeed, fitness sensors offer high potential for cross-curricular work. Short of this, Caroline Skerten suggests seizing opportunities to reinforce knowledge gained in other subjects. "You have to say, 'Remember you've done this in biology,' otherwise they don't see the connection."

Bringing it together

Body/mind is a false dichotomy. Together, ICT and PE link physical and mental activity, practice and theory. When taught with technology, PE can turn sporty youngsters on to academic subjects, while also luring their bookish classmates out on to the playing field. Ultimately, the use of ICT in PE helps to create integrated, rounded individuals.

Anne Barton, Head of Eltham Green Specialist Sports College, explains: "ICT brings together the academic and the physical in a way that wasn't possible before. You have studious children who don't like PE because they think of it as running around a muddy field and being part of sweaty teams. A fitness room equipped with ICT introduces another dimension to the subject. Then it's not just physical exertion. It's also mathematical data displayed on a whiteboard. You can video a long jump and overlay two film sequences to compare the arc and timing of each jump. At the same time, for those who prefer mud and sweat, ICT makes the science of sport come to life."

Linkage of two disciplines introduces variety, which is a plus in itself. A fresh approach can reach students who have failed to respond in the past. Combining the cerebral with the kinaesthetic also reinforces prior learning. The best ICT is interactive – almost muscular, in a sense. Interactivity, a teacher explains, "keeps kids awake. It helps them concentrate a whole lot better" on theoretical work. It does this through its liveliness and the fact that it requires a response.

Teachers report using ICT much more at GCSE and above. There are two reasons for this. First, theory becomes increasingly important and ICT helps put it across. Secondly, A-level timetables are more conducive to use of a tool which takes time to set up. "It may be only 10 minutes," Mark Colman explains, "but it's at the same time as taking the register and supervising the changing rooms." Some schools have PE technicians to help.

At any key stage, fitness sensors lend themselves well to cross-curricular work, as we have just seen. The same is true of visualisation software. Steve Kibble provides an example: "If you film a child throwing a javelin, you can then use a 'draw' tool to show the angle of release. You can export acceleration data from the video into [spreadsheet software] and draw graphs showing the connection."

Far-sighted teachers have identified links to almost all other curriculum subjects. Caroline Skerten's department supported design and technology colleagues in a project to design a



running shoe. Some science and design and technology teachers were trained to use the PE department's visualisation software. Likewise, athletics lessons were linked to spreadsheet work in mathematics. Both collaborations were one-offs.

At Eltham Green Sports College, says Richard Little, "We try to ensure that sport impacts on everything we do." English classes write up accounts of school matches. Design and technology classes study food and nutrition in a fitness context. Mathematics classes go orienteering. For revision, the PE department introduced quizzes modelled on *Who wants to be a millionaire?* Students used remote controls and audience response software to vote for the correct answers. The modern foreign languages department then adopted this technology for teaching French vocabulary. Science uses sport case studies and PE lessons refer to the relevant science.

Richard explains that these linkages reinforce learning: "When writing science essays, students can cite practical examples from sport. It puts the science in a context, which is very important for their understanding." And it works both ways. Martyn Williams, a science teacher at the Alice Ottley School in Worcestershire, uses light gates and a video camera with a built-in clock to teach the concepts of speed and acceleration in physics.

17 PE teachers' recommendations in unpublished report of 1991 Fischer Family Trust good practice conference.

Some schools, however, use dataloggers in science, graphical calculators in mathematics and fitness sensors in PE without yet linking the three. Whole-school curriculum planning could exploit this powerful crossover potential and could also promote joint purchasing, as suggested earlier. Science and mathematics departments, by virtue of their core curriculum status, tend to have greater access to funds. In any case, leading teachers recommend dialogue with other subject colleagues to save redundant effort. "Tell other departments, especially science, what you want to do. They may already have done it."[17]

At the very least, PE departments must have access to school intranets. An HMI subject specialist observes, "If you're linked in to the school network, you can tie in with other things happening."

Inclusion

Sport is a universal language, so PE can provide a channel for an academically challenged, disaffected or immigrant child. ICT's emphasis on visual, more than verbal, intelligence gives it a similar advantage in these contexts. The celebrity associations of sport and the arcade evocations of ICT lend cachet to both subjects. Linked together, PE and ICT create a powerful force for inclusion.

Mike Rimmer, Head of Personal, Physical and Social Development at Buttershaw Upper School in Bradford, describes a high proportion of his students, even at A-level, as "academically needy". He engages them by using presentation software with an electronic whiteboard. Mike's A-level classes take place almost entirely in an ICT suite. As he lectures, his students summarise key points, using word-processing. His slides remain available as an *aide-mémoire* and revision tool. He also makes extensive use of interactive on-screen worksheets and tests.

Mike explains: "This helps them with the theory. The very kinaesthetic, visual and interactive style of learning enhances key skills that they can then use in other subjects. Writing is difficult for our students and textbooks turn them off, but this approach works well. It motivates them. ICT gives us that extra

angle to tackle learning. It's the excitement of learning in a different way."

Previously, Mike used 'chalk and talk' and a photocopier: "The old way relied on kids taking notes and drawing diagrams for their folders. If they were absent, they missed out. Now they can always get my slides. Most don't carry folders around as they used to. They carry floppy disks or USB keys."

Presentation software helps Mike's A-level students focus their ideas and build logical arguments "by giving them a structure to follow". For A-level work on sociological factors in sport, students researched crowd violence at football matches, focusing on a notorious incident in which a player kicked and punched an abusive spectator. Mike was impressed by the appropriateness of the images they chose: "They went out of their way to find vivid pictures which conveyed their ideas with great clarity. You could see exactly what they were talking about." Though verbally unsure of themselves, these students were visually articulate, even eloquent. ICT enabled them to display and utilise this strength.

Alistair Bridle is Special Educational Needs Co-ordinator and Inclusion Co-ordinator at Medina High School in Newport, Isle of Wight. He was brought into the school to develop "an alternative curriculum for 30 kids that no one could manage". Previously a PE teacher in London, he combines outdoor activities with ICT to inculcate life skills. "They like doing PowerPoint presentations about challenges we set them. It looks as good to them as a presentation by someone who's a lot cleverer than they are." For a week-long programme at an activity centre in Kent, students used computers to plan and cost the expedition in advance and produce a newsletter afterwards, describing the experience. Digital cameras helped them create a visual record of what they learned. They felt proud when the activity centre used their newsletter in its publicity.

As Alistair explains, such a project also prepares students for further education. "If I can get them into college, they'll have to use a similar process of planning, gathering evidence, recording, reviewing, showing an examiner what they can do."

Technology suits short attention spans, says Alistair. "When kids take a digital picture, it's ready immediately, unlike a drawing. It's an instant way for them to see success. These kids can't draw straight lines or write paragraphs. They don't know how to start and then they want to finish immediately, but they can use a camera and writing frame. They like to record what they've done and they're quite literate on the computer. It's more engaging than the usual approach. The crispness and immediacy of the result pleases them. They do a newsletter and it looks like a newsletter. It builds their confidence to see that it works. They run to the printer and watch the pages coming out. 'Look! I did that!'"

Echoing a point made by Mike Rimmer, Alistair observes that ICT also helps his students keep their work together: "These are kids who can't keep anything. They come to school without their bags or folders. With ICT, their work doesn't get eaten by the cat."

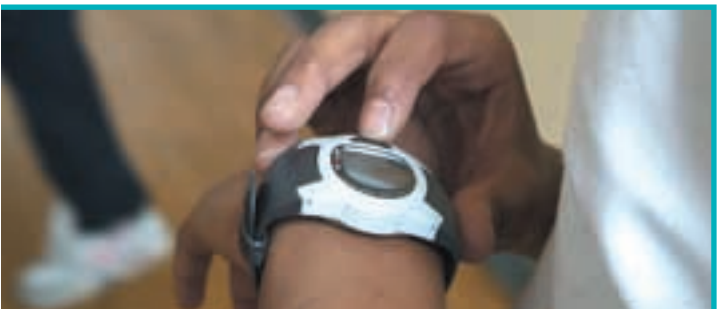
Day to day

Preceding sections of this report have described ways in which technology transforms the teaching of PE. However, as noted throughout, transformational usage is still the exception.

Responses to surveys by the Fischer Family Trust suggest that PE teachers use technology much more frequently outside lessons than within. Use tends not to be subject specific. That is, teachers tend not to use the tools or approaches unique to PE. Most have not been trained to do so.

Some typical uses are listed under Findings and Inclusion, above. Other increasingly common uses involve tools used across the curriculum, but with specific applicability to the PE environment. For example, on the playing field, teachers have begun to use PDAs to take the register and make notes on performance.

PE teachers also use technology to book and cancel fixtures. Dr Gareth Stratton of Liverpool John Moores University describes how this usage evolved: "Teachers would schedule a match. On the day, it would look like rain. Should they reschedule? They'd walk around the school, trying to find a phone that wasn't in use. They couldn't reach each other. Eventually, phones were superseded by email, but you had to get to a computer. Now teachers text each other on their mobiles. Until recently, this would have been regarded as cloud cuckoo land. Today, it's commonplace." Similarly Gareth points out, GCSE and A-level moderators used to visit each other's schools to view performances directly. Then some began to post videos to each other. Now they can send them by email.



Mark Colman of the Arnewood School, Hampshire, has created an online assessment package which all his colleagues use. In a subject such as PE, where teachers move among several locations, electronic assessment materials are more convenient to use. They also save space. One set of electronic spreadsheets replaces ranks of filing cabinets. "You can access the information from any classroom – if you're on a cover lesson, for instance. You can access it from home or wherever you are." Several teachers can access the system simultaneously.

Mark's package is a matrix applying four marking criteria and the National Curriculum skill levels to all sports taught at Arnewood in Key Stage 3. It will soon be extended to Key Stage 4.

At Buttershaw Upper School, Mike Rimmer uses a similar package to monitor students' progress on a half-termly basis. The system gives him a quick way to highlight areas where progress isn't taking place as quickly as it should be, and this information can then be used to inform planning.

As in all subjects, PE teachers use technology to stimulate their students. Richard Little of Eltham Green Sports College explains how state-of-the-art equipment can be motivating in itself: "Our students see that something new and dynamic is happening in PE, so they want to be part of that." Entitlement to use the best equipment flatters and inspires students. "In that environment, students take a few more risks. They are willing to put themselves on the line a little bit more."

Mastery of basic ICT tools like email and digital photography leads teachers on to higher-level applications. Angela Finch is Leading Edge School Co-ordinator and Head of ICT at The Byrchall High School in Wigan. Previously a PE teacher at the school, her initial acquaintance with ICT simply involved the use of photos from a digital still camera to illustrate worksheets. She explains that her usage then evolved "through trial and error and my interest in developing different teaching styles to raise standards". Having used still cameras, it "seemed a natural progression" to use video and visualisation software.



Practicalities

In using ICT, PE teachers must take precautions over and above those which apply in other subjects. Trailing wires and wobbly tripods pose safety hazards at the best of times, even without exuberant youngsters running about. Rob Williams of The Byrchall High School cautions that filming is safer for some sports (gymnastics) than others (hockey) and recommends that wires be taped down.[18]

In addition to safety, and the 'faff' factor mentioned earlier, video equipment is very theft prone, especially on playing fields. Nigel Green is eloquent on the subject: "Security is an increasing problem, particularly with projectors, which are quite a fashion item at the moment. We have had many things stolen – laptops, televisions, digital cameras and CD players, all of which were marked with the name of our school in large letters. We once put a television in the gym store overnight and it went out through the window. Televisions in a small store room were stolen by smashing through the sky light, which is now boarded up. A camera went missing from our office where it was being charged. Opportunist child! So we are more careful now, but it shouldn't be like this, should it?"

Mark Colman has been more fortunate. The Arnewood School keeps its laptops and PDAs in a special safe which also recharges their batteries. Each piece of equipment has to be signed out if used. Nothing has gone missing.[19]

The potential for damage is also a worry, however. Technology used in PE must be especially robust. The surge of physical activity in a PE class, and the fact that much of this activity occurs outdoors, necessitate this. PE teachers are peripatetic, so portability of equipment is also at a premium.

There are further, more subtle requirements. For example, a powerful backlight is a useful feature for devices used in bright sunshine.[20]

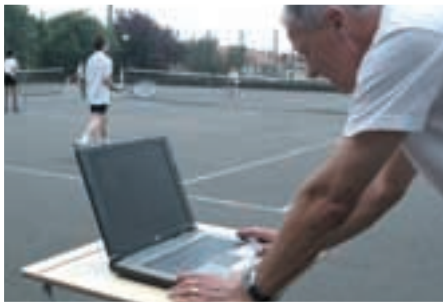
Planning and product mastery both take time and dedication. Angela Finch has found that use of video cameras and visualisation software "has taken a lot of extra work outside of lessons". Her colleague, Rob Williams, offers the following cautions and tips: "Set-up time reduces with practice but doesn't go away altogether. …Many student teachers are now highly competent with ICT and can be a valuable resource. … Ask IT teachers about transferable skills the pupils have. This will save time explaining information pupils already know. …Try using equipment at home, then in extra-curricular activities where time is not as important, before using it in lessons."[21] Other teachers advise: "Make sure there are lots of batteries available and charge them prior to use. Label everything. Keep it simple and do the lesson first without an audience."

18 Rob Williams, *BPRS Project 2003/2004*, p.21, p.23.

19 Hugh John, 'In shape for learning,' *TES Teacher*, 28 March 2004. Also see the Lapsafe website. [http://www.lapsafe.co.uk]

20 Hugh John, *ibid*.

21 Rob Williams, *BPRS Project 2003/2004*, pp.21–24.



Spreading good practice

We have seen that cutting-edge use of technology is rare in PE and yet there are inspiring exceptions. Where is innovation coming from and what conditions foster it?

Certain counties are hotbeds of good practice and this is no coincidence. Innovation occurs in clusters, sparked by committed advisers in county or local authorities, university staff who consciously cultivate disciples, dedicated teachers who champion ICT in their departments and combinations of the above. The most productive outcomes occur through symbiosis between a teacher-enthusiast and an outside expert. Prophets in the wilderness are critical to this cause, because the landscape is indeed a wilderness. ICT in PE does not get the central government emphasis or attention accorded to ICT in mathematics or ICT in science.

Steve Kibble and one of his colleagues[22] have pioneered the effective use of visualisation software in Devon schools. To do this, they created a professional development initiative laced with incentives: free training, a supportive community of peers and matched funding for digital projectors. Says Steve: "We oiled the wheels to make sure teachers could become involved with as little hassle as possible. The LEA levered money to make it irresistible to become part of the project. Schools bought their own laptops and cameras. We gave each school £5,000 on a matching basis to pay for projectors. When schools put their own investment in, they're more committed."

Their project on video-based learning in PE centred around 14 PE teachers hand-picked from nine Devon schools. As Steve explains, they deliberately chose a mix of participants: "Three had no ICT background, three were heads of department with some ICT literacy and the rest volunteered out of interest. We were trying to create experts in each department."

In the first year, the teachers came together once a term. They were given training and a challenge to take away. They later regrouped to share their experiences and receive further training and assignments. They have since become a self-supporting community, freeing the county advisers to spread the approach to a second group of schools.

Throughout the project, Steve Kibble and his colleague listened carefully to teachers' concerns and adjusted the programme accordingly. They also spoke with their software supplier: "We gave the company feedback from the chalkface to help them develop the product to the point where it was good for teachers." The initiative has been such a success that Devon is extending it into science and modern languages.

Steve explains how the county–school partnership works: "Advisers carry enormous credibility, as well as having the dissemination infrastructure. They are catalysts, providing information to teachers and challenging them to move forward." However, he acknowledges, "it normally starts with a teacher who has a vision. It needn't be a techno-freak, just someone with enough confidence not to let technology become a stumbling block."

Similarly, from his base at Liverpool John Moores University, Dr Gareth Stratton set out to create a cadre of teacher-apostles who could disseminate good practice into the wider school

22 Steve Cayley, an ICT consultant to Devon Curriculum Services.

community: "What I did was say to our students, 'You are the pioneers. When you get into school, share this. It will take time to roll out.'" His students would come up with ideas for using ICT. They would then test these out in the schools where they were doing teaching practice. This let them carry out reality checks with experienced staff and thereby stimulated their interest. "We started getting a trickle of interest back from the schools," he says. "Most senior teachers were resistant but some regarded it as brilliant. They saw our trainees producing resources and planning their use. The importance of planning began to get across."

Concerned by the apparent lack of PE-specific NOF training, Gareth's department also set up an Inset course, which it advertised locally, although teachers started to come from all over the country. He estimates that 1,000 skilled teachers have since emerged from this nucleus and are "out and about, sharing good practice".

Angela Finch of The Byrchall High School helped Gareth teach the Inset course. Gareth says, "She had a master's in IT *and* was a qualified PE teacher and Byrchall was a beacon school, but their funding was not out of the ordinary, so they were a good one to work with, to test what was possible." The two educators developed a powerful synergy: "We were spinning ideas back and forth." Describing the complementary nature of their partnership, Angela comments, "He had the luxury of coming up with bright ideas. I could tell him what wouldn't work in school. Sometimes he would talk me into trying it anyway."

Byrchall's status as a beacon school[23] meant that Angela and her colleague, Rob Williams, were given the opportunity, the equipment and the money to try things out. Then, when they decided to introduce visualisation technology, says Angela, "the LEA was keen and bought it for us. They wanted us to lead, because they could see the potential." Innovation in the school attracted outside support, which in turn spurred more innovation, but the starting point, in Angela's view, was personal ambition. She and Rob both had the drive to complete master's degrees "and spend time sorting out the practicalities of using ICT in lessons".

At Deyes High School, which helps train PE teachers, Nigel Green has created a similar dynamic. "Keen trainee teachers do a lot of dissemination. One of ours got a job on the basis of his ICT expertise before he even finished his practice teaching. Even in sports colleges, which are supposed to lead the way, you don't get innovative use of ICT unless there's a keen individual driving things forward." The key is to start with something cheap and cheerful. To spread good practice, "You've got to make it easy".

Individual leadership plays a lesser role in the use of ICT in core curriculum subjects. Nigel Pressnell, Deputy Head, notes that the Arnewood School "placed tremendous emphasis on staff training for ICT in science, whereas in PE the innovation has come from one or two colleagues".

Mike Rimmer's career history weaves these strands together. His mathematics dissertation in 1981 involved using ICT to calculate flight paths of a shot-put or discus under various conditions. He then used word processing with his students long before it was commonplace. This caught his LEA's attention and led to further opportunities. He says, "My interest and enthusiasm have driven the whole thing. Initially, I brought in my own equipment from

23 It has since become a leading edge school.



home to show senior management and colleagues what could be done." Now, the school makes funding available and, within his department, Mike says a good core of staff are convinced of the value of ICT in PE. "Out of nine, four are very competent. Two are more enthusiastic. Three would rather leave it alone, but that's fine because they're fantastic teachers and do a wonderful job without it."

Tolerance of colleagues' reluctance helps to win converts in the end. Caroline Skerten appreciates that it was difficult for some of her colleagues to get used to ICT: "They're not all geeks like me. ICT was my second subject at college, so I'm not scared of trying things out. Other people may think they'll break the computer if they press the wrong button. It takes a lot of me saying, 'You can't hurt it.' People are also scared of looking stupid if it goes wrong. What you need is willingness, time, training and practice, and a department that will give you that." As if to underscore this final point, Richard Little explains that part of his remit at Eltham Green is to be innovative, and he is given additional non-contact time to make this possible.

These are early days for ICT in PE. Departments are in a state of flux. Teachers are gradually gaining new resources, but even those in the forefront cannot begin to know the possibilities. With poor health and obesity rising, it makes sense to fund the double-barrelled solution of sport plus ICT.

In Devon, the approach piloted in PE is now being tried in other subjects. Across the UK, teachers interviewed for this report are propagating good practice. As they succeed, PE departments might well lead the way in integrating body and mind across the curriculum. This seems a natural role for PE teachers. After all, teamwork and leadership are what they teach.

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08/DD05-06/2031/96/pdf

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