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How Good Practice in Virginia Can Influence Change in England: Trans-Atlantic Lesson Drawing in the Use of Technology in Teaching

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The Context of Policy Making on Information and Communication Technology (ICT) in Education

The quest to make more effective use of ICT in subject teaching in schools is a major aim of education policy on both sides of the Atlantic. Both British and American Governments have over the past four years formulated policies intended to enhance the power of ICT in schools. Devising a strategy for change for which there are no precedents or "institutional memory," is an enterprise fraught with difficulty, both for the civil servants and ministers in the government's educational decision making machinery and for the local authority administrators, institutional managers, and teachers who are charged with making the policy work. For the British Government, the current challenge of implementing its National Grid for Learning (NGfL) is by necessity, a process requiring innovation and the search for intelligence about how to make best use of technology. For this reason, it is an aspect of educational reform, which has been characterised by a search for relevant knowledge and exemplar at all levels, particularly from the U.S. These, as we noted in the conclusion, are the most effective lessons to be drawn from the Virginia experience.

Our case study of the effective use of ICT in subject teaching in Virginia is particularly relevant to this search for knowledge because it focuses on those aspects of the system which are of greatest interest to government–the development of teaching and learning strategies which make effective use of ICT. Yet, more importantly, it offers valuable lessons for educational managers and teachers seeking examples of good practice to emulate in their own teaching.

There is some evidence of borrowing, lesson drawing, or transfer taking place on education policy between the United States and Britain. The NGfL (Department for Education and Employment (DfEE), 1997) was heavily influenced by President Clinton's 1996 National Plan for the Use of Technology in Schools. The Department for Education and Employment (DfEE) has made frequent reference to lessons that can be learned from the U.S. experience and there is a marked similarity in the language and symbolism adopted in the promotion of the policy in both Blair and Clinton's government. Both have talked of information superhighways and the stimulation of public–private partnership. The British Government has adopted a U.S. agency approach to policy development in schools in establishing the British Educational Communications and Technology Agency (BECTA) to oversee the implementation of the NGfL. In drawing lessons from the States on education policy, though, the New Labour Government is continuing a well-established pattern of policy making in recent times (Dolowitz, Hulme, Nellis, & O'Neill, 2000). During the 1980s the Conservative Government embarked on a series of intelligence gathering visits to the U.S.; indeed, the Secretary of State for Education, Kenneth Baker visited the States in 1987 seeking examples of market-based school systems. As a result, the U.S. magnet schools, founded on public and private funding, formed a model for Grant Maintained schools in the 1988 Education Reform Act. However, what was left behind was as significant as what was borrowed in this case (Hulme, 1997). In the U.S., the market system in schools had a significant commitment to social justice. The Chicago magnet schools, which served as a model for lesson–drawing had, as a central focus, de-segregation of disadvantaged communities and featured a significant redirection of state funds for low-income and special needs students. The British Government, however, sought a market model but filtered-out those aspects that did not suit their ideological purposes, and social inclusion was not on the agenda.

The major lesson for our case study was that education policy learned by practice elsewhere is likely to fail unless sufficient notice is taken of the context of practice both in the place where the policy originated and in

the transferring country. The most effective transferred knowledge is that which comes from the bottom-up, from organisations seeking good practice from each other, academics seeking to diffuse their research and, perhaps, organisations offering solutions as entrepreneurs (this can include private sector bodies such as software companies and telecommunications providers). It is for this reason that, in offering our "lessons from Virginia," we focused on those aspects of educational practices, which are most effectively transferable. In effect this means a focus on resourcing, the sharing of good practice among teachers, and inter-school co-operation, or the development of communities of learning.

At the end of the article, we return to this broader theme to evaluate the lessons, which can best be learned from the effective use of ICT in Virginia's schools at three levels:

- policy and decision making at central level;
- regional and institutional management of education; and
- individual teachers seeking to make better use of ICT in subject teaching.

Why Was Virginia Chosen as a Case Study?

Virginia is one of three states that took a lead in implementing the National Plan. Governor James Gilmore made it an aim of his office to make Virginia a technological innovator. Virginia's policy on ICT has featured the creation of centres of excellence as exemplars of technology-rich learning environments. In some cases, such centres acted as innovative providers of continuing professional development for teachers. Equally significant is that Virginia was implementing statewide Standards of Learning (SOLs), tests comparable to SATs in the UK. The state's approach was to integrate technology into the SOLs as much as possible. All of Virginia's school districts have implemented competency targets for all students and staff in technology across the curriculum.

A very significant feature of education in Virginia was the innovative role played by higher education. Virginia's two largest publicly funded higher education institutions, the University of Virginia and Virginia Polytechnic Institute and State University (Virginia Tech) have both forged strong relationships with networks of schools. Virginia Tech provided the central focus for our examples simply because it happened to be involved with the schools in our sample. The institution provided a good example because it pioneered the innovative use of ICT in a number of ways. With federal government and other funds it established, in co-operation with Montgomery County school authorities, the Blacksburg Electronic Village (BEV). Through this, a pioneering community network effort was made not only to change the quality and breadth of K-12 education (4 -18 years) but also to build a strong community of learning among all the parties in the educational process: schools, teachers, students, libraries and parents. In 1994 Virginia Tech received a planning grant from the National Science Foundation (NSF). The result was Planning a Virtual School in Blacksburg Electronic Village. The project, co-sponsored by Bell Atlantic, Scholastic Network, and Busch Entertainment, provided the resources for academics at Virginia Tech to work with school administrators and teachers to integrate use of web-based resources in subject teaching across the County. This innovative scheme allowed teachers to develop the skills required to author their own lesson plans and learning activities on the Web. Virginia Tech's own Web site proved to be a vital means of disseminating good practice in the use of ICT in teaching throughout its network of partner schools, spanning the whole state.

The Sample

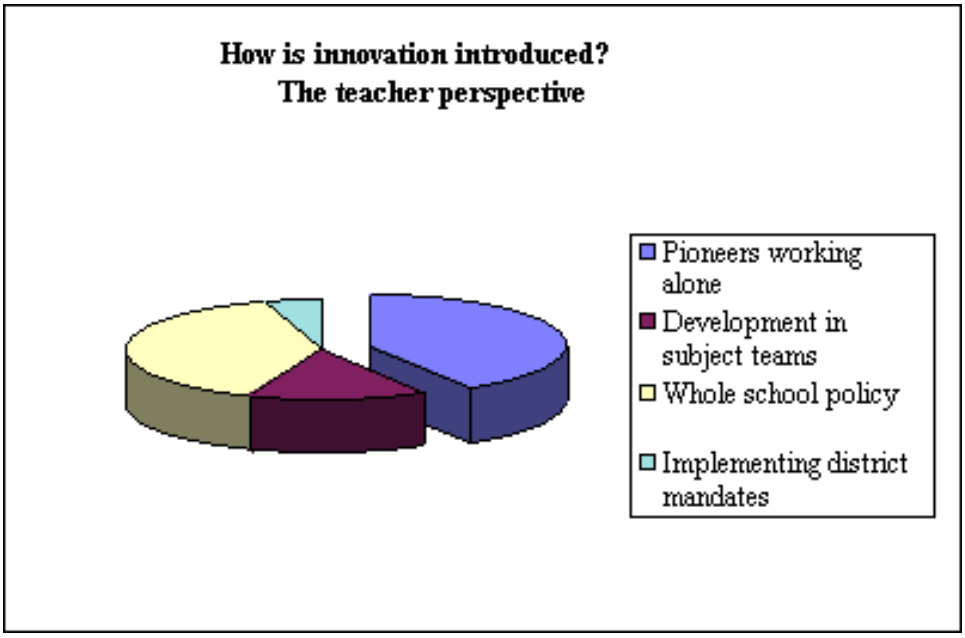
A multi-site, multi-method approach was adopted that captured the strategic and structural dimensions of the project. Research methods employed included a formal questionnaire to teaching staff, informal interviews with key personnel, for example, school Principals and technology coordinators, document analysis and observation of lessons. Thirteen schools across Virginia were included in the final sample: three elementary schools (k-5), five middle schools (grades 6-8) and three high schools (grades 9-12). Two centres providing specialist education in science and technology were also studied: the Centre for Applied Technology and Careers Education (C.A.T.C.E.) serving Franklin County; and the Roanoke Valley Governor's School.

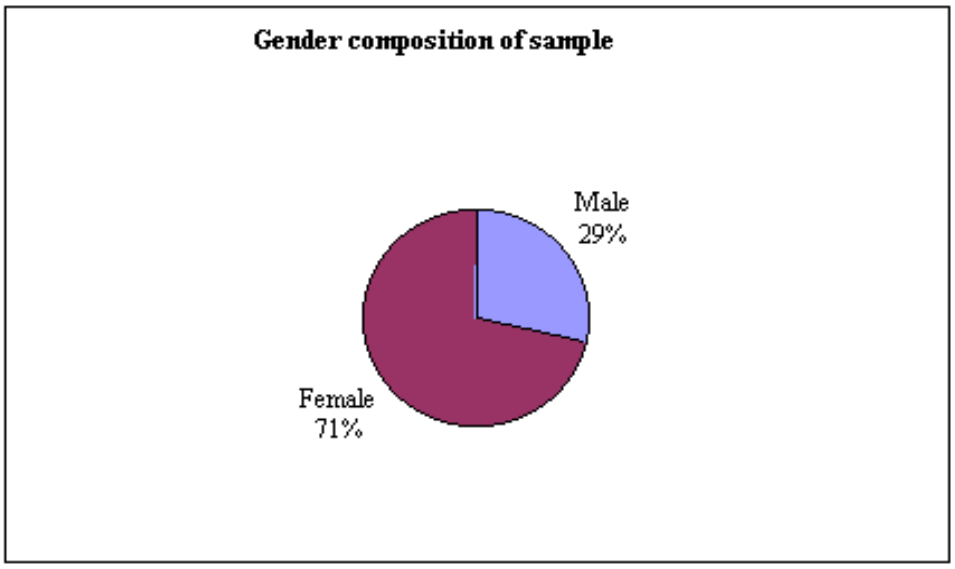
Auburn Elementary School

Burnt Chimney Elementary School
Falling Branch Elementary School
Blacksburg Middle School
Christiansburg Middle School
Paul Lawrence Dunbar Middle School for Innovation
Benjamin Franklin Middle School
George Mason Middle School
Centre for Applied Technology and Careers Education
Franklin County High School
Lynchburg Heritage High School
George Mason High School
Roanoke Valley Governor's School

The sample represents institutions were either well known or recommended for their innovative use of computer technology in classroom teaching. Nevertheless the sites varied considerably and served diverse populations; from small rural communities, to suburban and multi-ethnic urban areas. Falling Branch and Auburn elementary schools, and also the Roanoke Valley Governor's School, and C.A.T.C.E., are housed in state-of-the-art, new, purpose built accommodations. The Middle and High schools accommodated innovation in much older properties. Several of our schools were Blue Ribbon schools, an annual honour bestowed on schools by the State of Virginia for outstanding student achievement, instruction, environment and parental involvement. Many have successfully attracted federal grant money to fund innovation, (notably C.A.T.C.E.), or have forged extremely successful home-school-industry partnerships, for example, Lynchburg City Schools. Schools in Blacksburg, Christiansburg, Franklin County, and the Riner Community benefited from strong and productive links with staff at the Computer Science and Instructional Technology Departments of Virginia Polytechnic Institute and State University. Through various research and professional development projects the University provided training, equipment, technologists, and learning support for innovative practices in local schools.

A formal semi-structured questionnaire was distributed to all the teaching staff in the 13 schools visited. A total of 269 completed responses were collected. The response rate varied between schools from 55% to 90%. Forty-three elementary school teachers (16%), 128 middle school teachers (48%), and 98 high school teachers (36%) returned completed questionnaires. Seventy-one percent (190) of respondents were female. A greater proportion of staff at an earlier stage in their teaching career returned questionnaires (see Figure 1).





Length of service	
0 - 5 years	33% (89)
6 -10 years	19% (50)
11- 15 years	13% (34)
16 - 20 years	18% (49)
Over 21 years	17% (47)

How long have you been using computers in your teaching?

1 - 2 years	25% (68)
3 - 5 years	39% (102)
Over 5 years	36% (94)

Figure 1. Survey results

Results and Discussion

A very high level of computer usage was reported across our sample. Only five teachers (2%) confessed to never using computers in their teaching. Sixty-four percent (170) of respondents had begun to incorporate ICT in their teaching in the last five years; 25% (68) in the last two years. Training to acquire recertification credit may have been an influential factor in encouraging staff to use technology. Thirty-six percent (94) had experience of teaching with technology in excess of five years. There did not, however, appear to be an automatic relationship between length of service and willingness to incorporate technology. Forty-nine percent (44) of younger teachers had been using technology for at least two years but 64% (31) of teachers with over 15 years service were also incorporating technology in their teaching.

Teachers were asked to give their opinion of commercially produced educational software. Clearly the responses reflected general opinions on the range of software that is available and had been tried by respondents. Even from this superficial analysis clear trends emerge. The vast majority of the sample who expressed an opinion believed that commercial software was fine for curriculum enrichment (92%) and useful for basic skills remediation (89%). However many respondents (68%) believed that it was too expensive or reported a paucity of interactive material (48%). Concerns were also expressed regarding the ability to effectively measure learning outcomes derived from software use. A common complaint was that much of the material was insensitive to local needs, and not easily adaptable. Almost two-thirds of the respondents claimed that much of the material was not central to their curricular goals (see Figure 2).

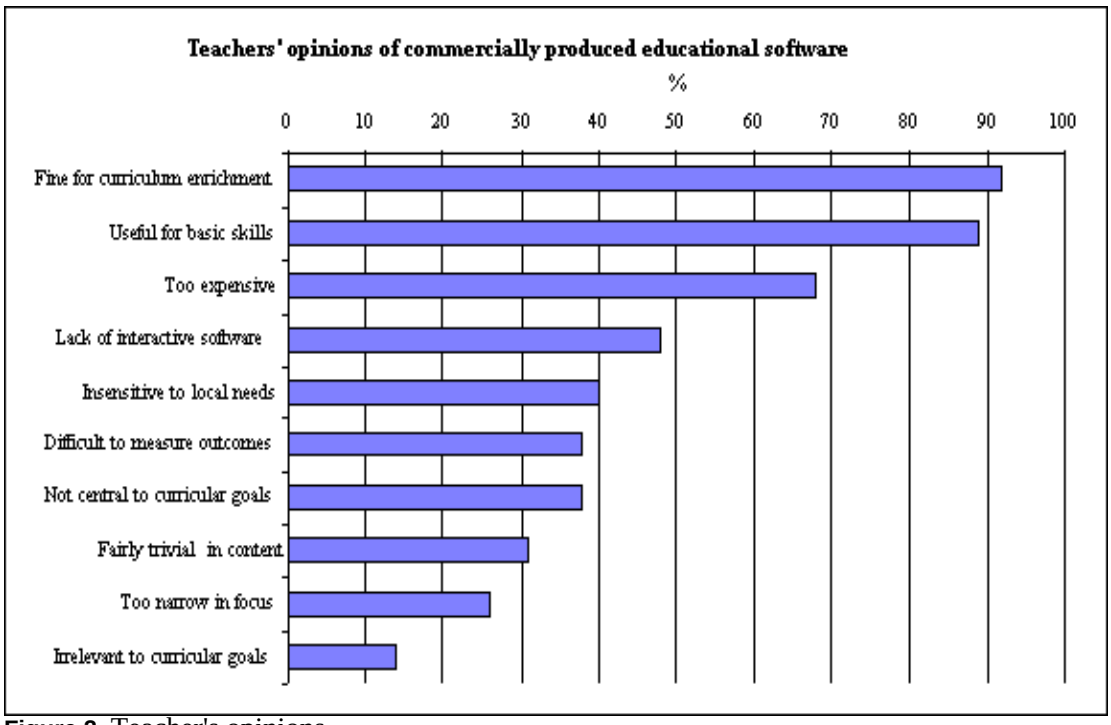


Figure 2. Teacher's opinions

Educational software and courseware evaluations have consistently revealed a disregard for the perspective and experience of the teacher in the design of materials marketed for the teacher. Firdyiwek (1999, p. 29) is among a growing number of writers who criticise the "lack of covert integration of pedagogy in courseware authoring systems." Developers too often "see their role more as technology providers rather than leaders, or even partners, in the exploration of (this) new learning environment." One provider of Web-based courseware systems stated that, "We don't tell instructors how to teach—we simply make the tools available for them to shape the content and delivery in ways which make sense for their discipline" (MadDuck Technologies, 1998). A problem with this stance is that the failure to engage in pedagogical issues by omission leads to an emphasis on repetitive practice, drills, testing, and grading as dominant assessment techniques. As Firdyiwek maintains, "The danger here is that technological convenience may take priority over sound pedagogy." Resnick, Greeno, and Collins (1996) have also highlighted the encroaching dominance of what they describe as the behaviourist/empiricist model of assessment. An evaluation of educational software must be contextualised within an understanding of how pupils learn. This is the missing dimension in current design that is so consistently highlighted by practitioners. Current constructivist educational theory and classroom practice is not sympathetic to behaviourist software design. Consequently as Squires (1999, p. 52) points out, teachers and learners are given a subversive role in which they must necessarily "reinterpret design intentions to suit their particular needs." Squires (1999) is among a growing number of writers who advocate the development of educational software for genuinely constructivist learning environments, that is, open-ended, exploratory, authentic learning tasks that encourage metacognition and enhance student motivation. Our study provided evidence to support Squires' claim that teachers routinely subvert the behaviourist design of programs: they assimilate it within a broader constructivist framework by providing linked resource material.

> Assessment should be focused on the outcomes of a cognitive apprenticeship namely articulation and reflection. The assessment methods we select should require learners to articulate what they know, not what we told them. Assessment should also require learners to reflect on how they came to know what they know" Jonassen (1996, 271)

This is certainly the philosophy in practice at the Centre for Applied Technology and Career Exploration (CATCE) established by Tammy McGraw in Rocky Mount, Virginia. All eighth grade students in Franklin County spend one semester at CATCE and one semester at the middle school. The Centre offers eight career paths: health and human services, legal science, finance, media design, arts, environmental resources, manufacturing, and engineering/architectural design. Students select three of the eight modules and spend six weeks on each module. At the Centre, students develop skills that enable them to solve problems, think

critically, and participate as productive members of teams. Innovative assessment procedures ensure that the work at the Centre is an investigative experience. Students develop electronic portfolios to showcase the work that they do at CATCE. Virtual environments, digitally performed original music compositions, animation clips, digitally generated images, web pages, architectural models, and multimedia presentations are a few of the products that represent what students have learned. Because of the specialised nature of much of the instruction and the Centre's desire to provide authentic experiences for students, an unusual staffing policy is employed. Master teachers are paired with practising specialists in the field to provide the best of both worlds: strong academic preparation along with true-to-life, real-world experiences. In the media design module, a master teacher with experience in journalism is paired with a former news director who has worked at numerous broadcast companies. A former tax attorney turned teacher has joined the staff of the legal science module. A retired IBM executive and a naval officer teach in the manufacturing module. Such staff diversity provides students with authentic and challenging learning experiences.

CATCE is also an important weapon in the battle to combat social exclusion. Franklin County is a rural and socially deprived region. Forty percent of adults aged over 25 years of age are without high school diplomas and 32% of schoolchildren receive free or reduced meals. CATCE is an attempt to awaken students early in their educational experience to the value and rewards of learning, careers, and work. Similar attempts to use technology to push forward educational and social reform agendas were found, notably at the Paul Lawrence Dunbar Middle School for Innovation and the Lynchburg Heritage High School. Both schools were struggling against Virginia's history of racial segregation and have successfully remarketed themselves as leaders of technology and innovative educational practice.

In contrast, innovative and constructivist-informed assessment regimes were also found in The Roanoke Valley Governor's School for Science and Technology (RVGS), which described itself as "a special alternative opportunity for motivated secondary school students." Students are selected on a competitive basis by local school district selection committees. Two hundred twenty students in grades 9-12 were drawn from seven rural, suburban and urban districts in southwestern Virginia and attend science, math, and technology classes for half a day each weekday. The remainder of their time was spent at their hometown schools where they study English, history and social studies. Technology was integrated throughout the curriculum. Particular focus was given to integrative teaching and learning with connections between and among disciplines. Curriculum strands emphasised hands-on experience in research and experimental design. Extensive use was made of sophisticated hardware and analytical methods. Saturday and evening workshops staffed by faculty were extremely popular. Instead of the traditional two-semester schedule, the RVGS operated a trimester system that allowed for an Intersession dedicated to a single, research-oriented elective. Students used the Intersession to investigate an area of personal interest. As a result RVGS students had considerable success in regional, national, and international engineering competitions.

One solution, to counter the weaknesses of commercially produced educational software underpinned by behaviourist principles, is to encourage the local development of technology-based materials. Teachers in the survey were asked what factors would be most likely to fuel this development. Support was strongest for the factors listed in Table 1.

Table 1: Support factors

	Definitely	*Possibly*	*Unlikely*
Designated funding	93% (195)	62	11
Availability of on-site technical support	70% (187)	72	9
Professional release time	63% (170)	86	12
Greater confidence in the use of computers	61% (164)	83	21
Increased availability of computers on-site	59% (159)	78	31
Provision of technical training workshops	54% (144)	106	18
Greater collegiality, instructional sharing	53% (143)	103	22
Recognition & encouragement from managers	46% (124)	108	36

The results from the questionnaire corresponded closely with the interview responses. Time and time again staff argued that funds needed to be made available to support teachers; first in freeing time to enable professional and curriculum development, and second to provide ongoing technical support onsite when needed. These issues were seen as the greatest barrier to grass roots innovation. There are clear implications here for funding. Innovation at CATCE is supported by a five year $1.5 million grant from the U.S. Department of Education's Technology Innovation Challenge program. Staff development and support services are afforded a high priority. All staff received a compulsory training entitlement at the County's Regional Technology Centre and must demonstrate technology competencies for recertification. A third of RVGS's funding comes from the State Department of Education. The rest comes from student tuition paid for by each district school board. The technology program costs $50,000 each year to maintain. Staff follow an individualised Professional Development Plan which operates on a credit scoring mechanism. Each member of the staff must accrue nine points per annum. Three points are earned for individual initiatives, for example, acting as a faculty consultant on a new piece of application software; two points for slightly more directed or small group activities, for example, incorporation of a technology application observed by formal peer observation; and one point for system wide activities, for example, publication in a technology-focused periodical or attendance at a professional conference on a targeted technology. The professional development model adopted at RVGS reflected recent literature which suggests that individual and small group in-service training programmes are usually the most meaningful and lead to more significant changes in classroom behaviour with respect to the use of technology in instruction.

Training must be relevant to the needs of the individual teacher, and teachers must perceive the benefits of using the technology as greater than the time and effort that their use requires. (The Technology Plan, RVGS, 1999, p.51)

It is encouraging that over half the respondents in our survey of 13 schools reported that innovative practice using technology was at least the product of curriculum development within subject teams (15%), if not the result of a coherent whole school policy (39%). Continuing high levels of perceived autonomy over classroom practice was demonstrated in the teachers' lack of regard for District mandates as an instigator of change. Only 5% of the sample felt that innovation was driven by state mandates. However, it is disappointing that 41% of our sample felt that innovation remained the product of individual pioneers largely working alone (see Figure 3). This indicated a lack of support and effective instructional sharing in several schools/departments where professional isolation appeared to be a problem. Elementary and middle school tutors were most likely to share instructional practice. Although a comparatively high degree of inter-disciplinary learning and also team teaching was uncovered in both the survey and classroom-based studies, this approach was most prevalent among middle school teachers who enjoyed higher levels of curriculum freedom and are also closely teamed. Small groups of staff collaborated routinely across subject areas in an attempt to provide quality pastoral care and meet the academic needs of students. Cross subject initiatives were common. High school teachers had greater difficulty breaking through the barriers of subject matter boundaries and an established culture of individual autonomy.

Individual pioneers/enthusiasts, largely working alone	41% (111)
Team-based coordinated effort by subject teams	15% (40)
Whole school policy, across subject training	39% (105)
Implementing District mandates	5% (13)

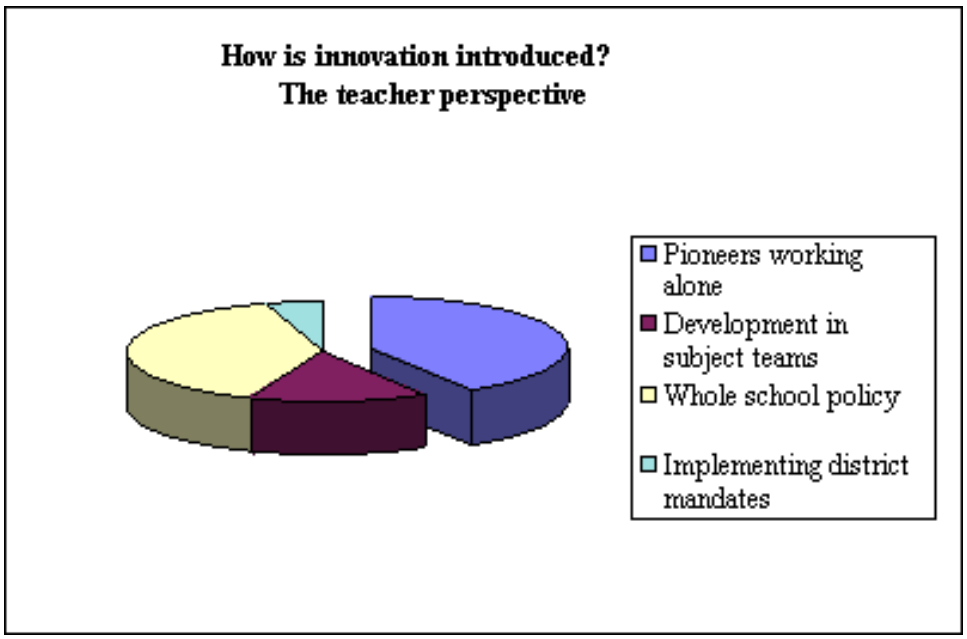


Figure 3. What stimulates innovative practices

There was a role for computer mediated inservice support networks for teachers. The electronic Academic Village at the University of Virginia links public school teachers, student teachers, and university faculty with teachers across the U.S. and globally (Bull, Harris, & Drucker, 1992). The Beginning Teacher Computer Network at Harvard, which has operated since 1987 provides support and mentoring for graduates in the first year of teaching. Novice practitioners are dispersed but retain an important support link with their teacher preparation program. The Network features materials requests, case studies and teaching method discussions for improved effectiveness in the classroom. Virginia Tech's K-12 Contact program links public school, university teachers, and their students through a series of interactive web pages. The web pages served as a site for the exchange of information and ideas and making initial contacts, from which a variety of creative partnerships and collaborations have grown. Since 1996 Paul Heilker, the Director of the Virginia Tech First Year Writing Program, has engaged in a concerted effort to build strong working relationships with local high schools using the K-12 network. These initiatives include: consultation on educational software and on the use of computer aided instruction; a non-fiction student writing contest and other internet based student publications; and telecollaborations with students at Christiansburg High School.

Telementoring has been a particular area of interest and development. With this structure, internet connected specialists from universities, or other schools, can serve as electronic mentors to students who want to explore specific study topics in an interactive format. An example of such a project is the Writing Relationship Through Technology project at the University of North Carolina. In this project a technology partnership was formed between an English specialist involved in teacher education and a sixth grade teacher at a local middle school. The university tutor was interested in helping the students become competent responders and guides for middle school students revision processes. The middle school tutor was interested in helping students revise their writing more effectively. University and middle school students communicated via e-mail.

John Carroll of the Department of Instructional Technology at Virginia Tech is conducting pioneering research into the educational benefits of Learning in Network Communities. Across a network of four public schools (Blacksburg High School, Blacksburg Middle School, Auburn High School, and Auburn Middle School), researchers are developing synchronous and asynchronous support for collaborative learning activities in science classes. Software support is being developed for group formation and group management, project brainstorming, video/chat/e-mail communication, a semi-structured shared notebook, and a synchronous workspace. Students work in same-class groups, same-age groups but cross-school groups, and both cross-age and cross-school groups on projects ranging in duration from a few weeks to a few months. The research team is assessing the impact of computer-enhanced activities on science learning (especially in relation to scientific method and experimentation), attitudes towards science and technology, and the development of collaboration

and communications skills. The work is funded by the U.S. National Science Foundation.

E-mail is proving to be an important tool in supporting learning contracts, mentorship and tele-apprenticeships (Paulsen, 1994; Levin, Haeson, & Reid, 1990). The generation of learning circles has much potential in supporting teachers incorporating higher levels of ICT in constructivist learning environments. Our research in Virginia has revealed many constructive examples of university graduate students, technologists, and professors collaborating closely with teachers and students in the classroom to improve practice.

Conclusion: Learning From the Virginian Experience

The examples of policy and practice in the use of ICT in subject teaching explored here, offer valuable lessons for the use of ICT in the British educational context. Three levels, at which the most significant lessons can be drawn, are offered.

Policy and Decision-Making at National level

In looking to America for inspiration in education policy, the British government has tended to look for a general direction to policy—information superhighways and public-private partnerships. Indeed, our study reveals that there is much to be learned on the general organisation and funding of ICT initiatives in schools. However, the most valuable lessons can be drawn from the classroom itself and the innovative means by which curriculum development is supported.

After four years in power, Britain's New Labour Government is still developing a policy style or approach to education reform but there are signs that the search for intelligence to inform policy is leading to a greater willingness to listen and accordingly more opportunities for bottom–up influences on policy making. Indicative of this is the government's recent announcement of a new consultation paper containing proposals for expanding continuing professional development for teachers. The views of those involved in teaching are being sought, particularly on the effective use of funding for professional development, with the objective of helping schools to become learning organisations. The government has committed six million pounds to a programme of research that will explore, among other ideas, the possibility of piloting professional bursaries and sabbaticals for experienced teachers (The Teacher, March 2000). The professional development activity, which we observed in Virginia, provides some very pertinent examples at this important moment of change.

Some of the most striking examples of innovative practice are consistent with the British Government's long standing approach of rewarding excellence by targeting resources towards Beacon Schools and rewarding individual Advanced Skills super-teachers. The Virginia State government's practice of encouraging professional development in the use of ICT by pairing master teachers with practitioners from business and industry would no doubt appeal to the DfEE and offers a model for public-private partnership in curriculum development.

The model of staff development offered by the RVGS whereby individual teachers must accrue points under a credit accumulation mechanism is resonant with the government's approach to performance measurement but might be difficult to transfer to the British system, given differences in organisational culture in schools. The state-wide model of compulsory annual re-certification to demonstrate competence is perhaps a more transferable model, though one that would meet with considerable resistance.

There are interesting lessons to be learned from the Virginia efforts to fund staff development. The approach recognises that innovation is the key and funds are allocated to specific programs and institutions, such as CATCE, the influence of which can be disseminated state-wide. Focusing resources in this way provides an appealing and realistic model for funding innovation in ICT use in schools. There is little opportunity to bid for external funds for curriculum development in U.K. schools and few opportunities to reward excellence outside the BECTA Awards Scheme or Beacon Award Scheme to further education colleges.

The creation of specialist institutions has been a central element of British education policy for some years. Our study reveals that some valuable lessons can be drawn from the Virginian experience of specialist schools. The extent to which CATCE and the Lawrence Dunbar School have been instrumental in empowering

disadvantaged communities offers a way forward for the New Labour's agenda to defeat social exclusion through school reform. Again though, support for staff development to integrate technology into the core of subject teaching is the key to this success and one not to be overlooked.

An aspect of the Virginian experience, which is central to all of these issues is the relative autonomy of staff to make innovative use of technology in their subject teaching. This of course, implies a curriculum which is primarily defined by teachers and schools, rather than government. This could provide a timely lesson for the present British Government as it seeks to unravel the rigidities of the old national curriculum and move toward greater flexibility in provision and school organisations [www.qca.org.uk/changes-to-the-nc/main.htm]. Our sample schools offer useful examples of the kind of benefits which specialisation can bring.

However, the potential for autonomous professional development is very gradually being constrained in Virginia. Recent Virginian initiatives on Standards of Learning tests (SOLs), echo very closely the experiences of U.K. teachers with the assessment of the National Curriculum. Virginian teachers were beginning to feel more constrained in a way in which their English counterparts would find very familiar. The publication of SOL scores was felt to be changing the way that the curriculum is delivered. It would be ironic if those aspects of the system in Virginia which gave teachers the autonomy to innovate were undermined by transfer of the crudest type of performance measurement, pioneered in the United Kingdom twelve years earlier.

Regional and Institutional Management

The most striking aspect of Virginia's regional development as an innovator in this field is the relationship which exists between higher education and schools across the state. Virginia's two largest, publicly funded higher education Institutions, Virginia Tech and the University of Virginia, both have strong relationships with the state's schools based on web-site development. The use of electronic mentors and the firm relationship between university departments, individual academics, and curriculum development in subject teaching are aspects of ICT innovation that ought to be emulated in the British context. The relationship is mutually beneficial. Schools gain the resource of academic expertise and the universities have developed a valuable network of partner institutions from which to draw prospective students from among the staff and student bodies. Often these links have been forged due to a combination of enterprising head teachers and pioneering academics. There is no shortage of either on this side of the Atlantic.

Lynchburg City authority pioneered by connecting all of its schools via fibre optic cable. This had taken a great deal of investment from local and state government and years of negotiation with telecommunications providers but it had helped to reap great rewards in ICT use in subject teaching in a city with considerable social disadvantage. There are lessons here for the new unitary local authorities seeking to find a distinctive policy on ICT in schools. In particular, there are practical lessons on the manipulation of commercial opportunities in order to deliver greater social justice through technology driven school reform. Lynchburg's community of learning is driven by Public sector partners and therefore provides a democratic model for English Education Action Zones and others seeking examples of collaborative practice.

Teachers and Schools

The strongest message from the research, concerned the need for teachers to receive appropriate training and concurrently, for the onsite provision of support for the use of ICT in subject teaching. The British government has begun to reveal an appreciation of this need through its emerging policy toward schools. The Computers for Teachers Scheme in England [www.cft.ngfl.gov.uk], provided by the DfEE, which offers a subsidy of up to half the cost of a computer (up to £500 ($810 U.S.)) is an indication of this new direction (albeit limited through its failure to factor in supplies to cover the training requirements and the fact that subsidies through this cash-limited scheme are subject to income tax).

In Virginia policy and practice on support for teachers varied. Some schools had appointed a teacher as Technology Coordinator, an increasingly important role in the school, specifically addressing pedagogical issues. Significantly, these individuals had been sufficiently empowered with time and resources to help teachers develop their own teaching materials. Other centres such as CATCE and the RVGS acted as technological resources in their own right. In both cases, the need for training and support had been acknowledged. Small group training was seen to be particularly effective and this, in turn helped the

establishment of learning communities.

The greatest aid to progress in the local development of ICT based teaching resources was the creation and growth of such communities. The sharing of good practice, by means of web-site use or e-mail contact, underlined the value of collaborative work whereby schools would engage in joint projects, sometimes spanning the sectors. The development of thematic packages of learning through the use of such collaborative approaches offers a great deal of potential to teachers in the UK. Clearly such practices already exist and international contacts will help to develop a form of transfer at the level of the classroom.

Finally, it must be stressed that not all of the aspects of good practice from our research are transferable to a British context. In many respects we are not comparing like with like. The United States has a Federal system of government and Virginia provides just one example of a state–wide initiative on ICT, albeit a good one. There are marked differences in educational policy and practice. Ironically, this is one of the main attractions of the U.S. to British policy makers. The U.S. system faces similar problems, often with different manifestations but there are many different test cases in terms of state governments attempting to find responses to them.

Such inter- and intra-state diversity makes the process of educational change a complex and fragmented business. The implementation of national agendas such as the National Plan is negotiated through a series of local agendas. Our case studies reveal that policy is all the better for this process. The British government should learn this democratic lesson in implementing the NGfL but it is unlikely to do so.

A major case in point here is the control of the curriculum. The most innovative practice, featuring collaborative work and inter-institutional partnerships, is made possible by the level of autonomy that Virginia's teachers retain over their curriculum, particularly in the middle schools. The scope for innovation is considerably curtailed within an English system in which the government, despite its recent reforms, still defines the National Curriculum quite tightly. There are, moreover, differences in the culture of school life in Britain and the U.S. The evident ascendancy of constructivist approaches in Virginia's schools, which allowed collaborative practice to flourish, may not be as evident in British schools and the scope for integrated, cross-curricular developments may be more limited.

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