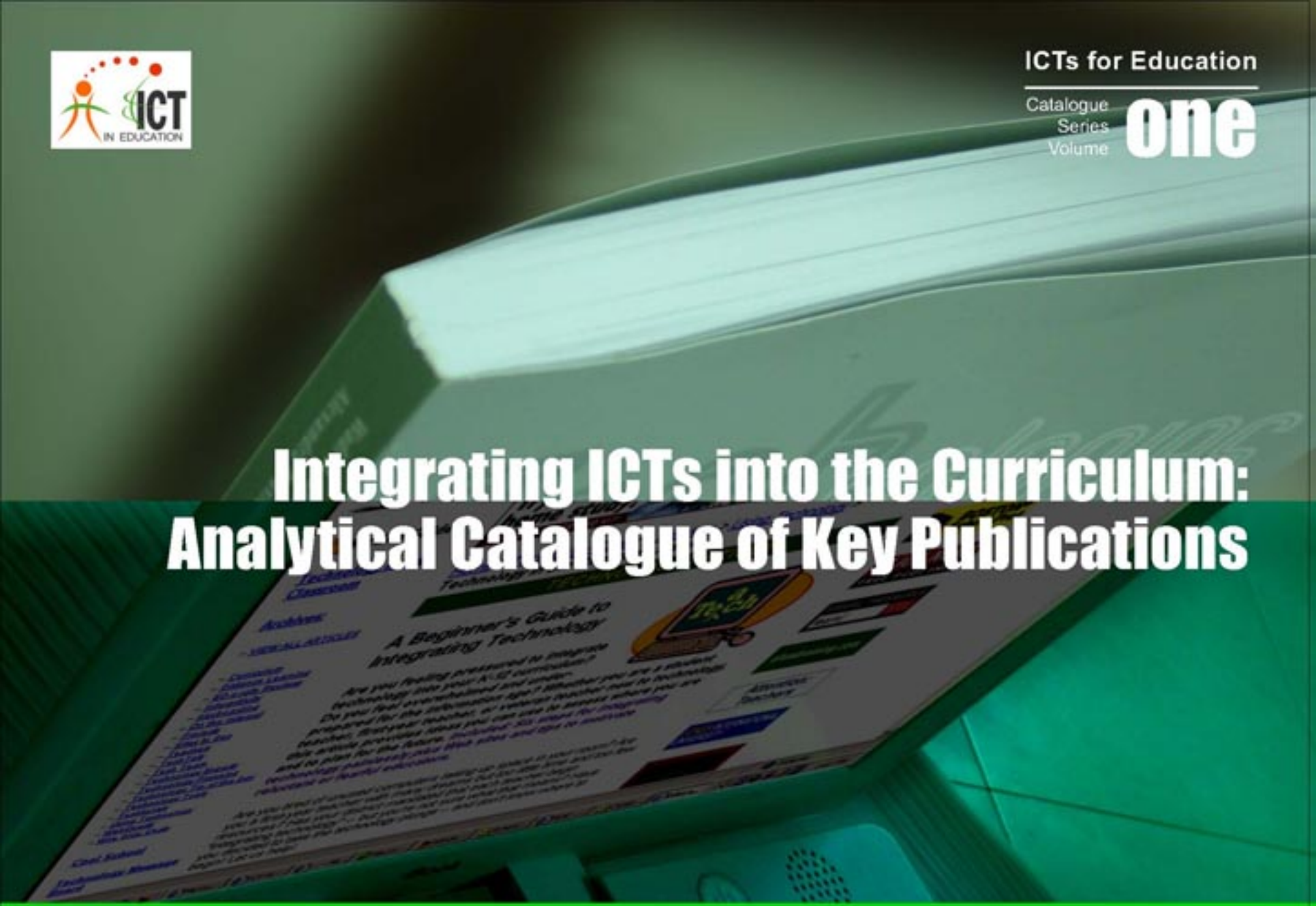
ICTs for Education

Catalogue Series Volume one

Integrating ICTs into the Curriculum: Analytical Catalogue of Key Publications



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Integrating ICTs into the Curriculum: Analytical Catalogue of Key Publications

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PREFACE

Although many excellent materials now exist that detail the full range of potential uses of Information Communication Technologies (ICTs) in education, already over-worked policy makers and others often lack the time it takes to surf the Internet, or access libraries and other sources of information on their own in search of ideas and material support (usually in a second language). In the Asia-Pacific region, leaders, educational managers and teachers have the added challenge of trying to enrich education with technologies that are often a recent introduction to the country, or in many cases, are not yet present. This is one of the main reasons why we set up the Regional Clearing House on ICTs in Education for Asia and the Pacific Project at UNESCO Bangkok. The Clearing House acts as an intermediary between this wealth of information and the busy users - namely, anyone involved in planning, organizing, or implementing an ICT vision, policy or project. This includes high-level policy makers, educational managers and staff development teams; to curriculum and educational content developers; teachers and non-formal educators; and educational researchers, evaluators and development workers. The Clearing House collects, analyses, filters, repackages and disseminates information on ICTs in education in Asia and the Pacific in a variety of formats, be it our Web-based portal, CD-ROMs or publications. In this way, the Clearing House promotes digital inclusion by providing fast, free and equitable access to knowledge and information to support policy formulation, management and monitoring, teaching and learning, community outreach, networking, and programme implementation.

As part of this process, this publication is the first in a new Catalogue Series on topical issues dealing with various aspects of ICT use in education. The purpose is to share the best of the wealth of materials available in our library collections, the Internet and other sources, and to alert readers to the contents and where they can be accessed. The series not only provides abstracts sythenesizing the content of each resource, but also excerpts substantive and useful parts of the book or electronic document. Each entry provides a distillation of the content in order to give readers the essence of the information without having to read the entire book, and includes bibliographic details, abstracts, excerpts, and key-words for easy referencing.

This first issue deals with integrating ICTs into schools. Many teachers have been using ICTs as productivity tools, but have never really authentically integrated these technologies into subject teaching. There is a need to learn from concepts, principles, strategies and experiences on what does, and what does not, make the integration of ICTs within education successful. For this reason, this catalogue contains detailed principles and strategies to help educators and others use ICTs in ways that can transform their teaching practice, based on experts' experiences of what does, as well as what does not, make for successful integration of technology in education. The strategies and guidelines also extend to school administrators, local educational leaders and government stakeholders with case studies describing educational policy reforms that have explicit ICT components as well as to government bodies developing ICT-based resources specifically for their national curriculum. This issue shares the best print and Web publications we found, as well as CD-ROMs, dealing with: General Principles and Strategies for Integrating Technology in Education and the Curriculum; Integrating Technology into the Classroom and Developing Lesson Plans that Integrate ICTs; Technology Integration into Specific Subjects; Requirements for and Barriers to Effective Technology Integration; Evaluating Effectiveness of Technology Integration; and Successful Case Studies of Technology Integration in Schools.

Carmelita Villanueva
and Cédric Wachholz

INTRODUCTION

The Analytical Catalogue of Key Publications

This catalogue contains a range of resources, in the form of books, CD-ROMs, online publications, websites and articles from e-journals, that aim to provide teachers, senior school managers, curriculum developers and administrators with guidelines and strategies for integrating ICTs effectively into the teaching and learning process.

The catalogue is divided into a number of sections, each with a particular focus area, and the materials have been purposefully gathered from a range of sources to provide as broad a perspective on the various issues as possible. For example, websites and publications from government agencies and departments of education are featured, such as the British Educational Communications and Technology Agency and the U.S. Department of Education, as are organizations such as the International Society for Technology in Education, respected online educational journals and case studies from regional and national primary and secondary schools.

Most of the resources included in this catalogue may be found online. For the print publications and CD-ROMs, we have included the publisher's details. All resources may also be found in the Information and Knowledge Management (IKM) library based at UNESCO Bangkok. Please contact IKM for further information: ikm@unescobkk.org.

TRENDS & RECOMMENDATIONS

The following gives a summary of the trends and recommendations identified by the various entries in the catalogue.

General principles and strategies

The planning stage is recognized as particularly important for effective introduction of ICTs into the curriculum. In addition to needing to know from the outset where the teachers and the students stand in terms of ability and ICT skills, consider what your and your school's learning goals are, and how these will be met. For example, when purchasing or developing materials, ask yourself questions such as the following: Does the product meet national and/or institutional objectives? Does the product contribute to the aims and objectives of the course? Is the content current, unbiased, and politically and socially sensitive? Is the use of text and media appropriate for the needs and objectives of the course? Can the product be used with locally available resources?

We see that in many cases, ICT-based lessons and materials are being developed in line with the national curricula described by ministries of education and local governments. There are case studies from Australia and the UK, for example, illustrating how educational software and ICT-focused lesson plans can be integrated into standards-based lessons, becoming part and parcel of curricular reforms. One article describes how, in the UK, the national curriculum underwent a series of reforms as educators went from recognising the value of technology education, but lacked any means of assessing student competency, to ICTs becoming a discrete subject in its own right, to its current status as a tool that is embedded across the curriculum used by teachers of all subjects. In this regard, the British Educational Communications and Technology Agency (BECTA) has been involved in developing and disseminating guidelines and materials for the integration of ICTs into subject teaching.

In terms of the practical use of computers, one of the key issues is whether they are located in the classroom or in ICT suites and laboratories. There are various articles and studies highlighting the relative merits of each location, depending on the context of the class being taught. Generally, it is shown that while a computer lab may tend to offer greater technical support, and can ensure that all students have access to a computer when otherwise this may not be possible, teachers find it harder to integrate the use of computers fully into their teaching practice. With computers strategically organized in the classroom, the teacher often is able to set up independent learning projects, which allow them to play a more facilitating role with the students taking greater responsibility for their learning.

Other articles describe the various kinds of activities available online: buzz groups, syndicates, WebQuests, collaborative projects, online debates, and treasure hunts, among others, which can easily be integrated into classroom activities and into the development of lesson plans. In general, there is consensus that the kinds of activity that best motivate and engage students incorporate collaborative learning, are student-centred, offer chances for independent learning, and are multi-disciplinary in their scope. Many also emphasize the fact that the curriculum must define the kinds of technology used and ways it is applied to student learning, and not the other way around.

The general principles and strategies found in this section often point to the fact that in many cases, teachers may have been trained in basic computer skills, often for administration purposes or perhaps simple presentations, but they

need greater training in being able to connect the potential of ICTs to the subject they are teaching. For real integration of ICTs into the teaching and learning process, teachers must be helped to understand how educational technology can inform and enhance pedagogy and, thus, contribute to greater student performance. In this regard, many experts emphasize continuous training as essential to teacher development, and a slow approach, expecting teachers to take anywhere between three and five years to fully adapt to the new technologies and related pedagogies. Other educators consider it important that teachers be trained on their own premises, and on actual hardware and software that they can access at school. Leadership, in the school and at the local government level, is also highlighted as integral to staff development, and this in turn calls for open dialogue between all stakeholders in the schools system, including private enterprises. Similarly, collaboration between local governments and private software developers is seen as very effective in ensuring educational software remains locally relevant and tied to specific curricular objectives, both of which are important for encouraging teachers to make use of available ICT resources.

Integrating technology into the curriculum and in the classroom

ICTs are transforming the curriculum in a number of ways, and the kinds of learning activities that promote higher-order thinking skills, which make use of all sorts of software and online project-based resources are, in turn, demanding that teachers re-think traditional pedagogies. All of this is having a deep impact on our understanding of the curriculum, in terms of what a curriculum is, who develops it and how, and in what ways ICTs can help students develop more critical responses to the information they access. It is noted that in some cases, the curriculum design may be the responsibility of individual schools, it may be left to local governments, or it may be developed by the national ministries of education in order to set standards for teachers and students, alike.

The curriculum is becoming more dynamic and interactive as a result of the many kinds of ICT-based learning activities, projects and software applications being developed. Students are being encouraged to engage in more independent, collaborative activities, able to work with pupils from schools in other regions and countries on projects that can cover many curricula objectives simultaneously. As such, curriculum developers are led to consider the curriculum from alternative perspectives – subjects do not necessarily need to be kept discrete, but ICTs can facilitate a cross-curricular, multi-disciplinary approach. Technology also enables teachers to approach the curriculum from the perspective of Multiple Intelligences (MI), with multimedia applications stimulating many ways of learning that have been ignored by traditional educational methods. MIs are described by one author in terms of each intelligence's relation to different kinds of technology. For example, assistive technologies, joysticks and the mouse on a computer offer great opportunities to explore the kinaesthetic intelligence, while message boards and discussion forums tie in well with interpersonal intelligence. There are also strategies for connecting various MI elements to national standards.

Specifically, resources describe the many kinds of application, software and Internet-based activities that enhance learning, and the key pedagogies needed to employ them effectively. Some of these resources are for quick reference, offering teachers ideas that they can then develop on their own; others go into more detail, describing how different media can play important roles at various stages of a lesson.

Examples include language arts classes that use news stories on video and the radio in conjunction with the Internet to develop higher-order research skills, while students with different intelligences can use recording equipment to help them prepare for writing exercises. Floor robots in math classes, CD-ROMs for research in science classes, and multimedia educational software in foundational subjects are also suggested.

Multimedia design projects are recommended as another effective way to develop students' higher-order thinking skills, while WebQuests are popular because they tend to focus the student on actually using information, not just acquiring it, and they must then analyse, synthesize and evaluate that information.

The Internet is a popular tool in many subject areas, and there are also useful tips for developing students' skills in searching for and retrieving information online. It is suggested that students be taught generic research skills applicable to any subject, while electronic and hard copy resources should be used in tandem, as students tend to stay on task better when they have prepared search questions before sitting down at a computer.

Integrating technology into specific subjects

Strategies described for integrating ICTs into specific subjects suggest that you start by looking at the scope and sequence or curriculum framework of the subject in question, and then identify specific sub-topics and their objectives. The teacher needs to decide whether those sub-topics and objectives lend themselves easily to the integration of ICTs, and whether these topics will benefit from the use of ICTs. The teacher must ask, what are the contributions ICTs will make towards enhancing student learning in this subject? Will ICTs offer the students the chance to develop their understanding of the subject in ways that would not be possible in a non-ICT-based class?

These materials include a sample of specific lessons that use technology in a given subject, such as language arts and modern foreign languages, as well as websites that provide detailed guidelines for using ICTs in all subject areas at both primary and secondary levels. A common theme is how the Internet can be used to make a given class instantly more engaging and relevant – for example, using news and weather reports for modern language classes; accessing primary sources to better engage students in history lessons; or going to famous sites such as NASA for exciting science-based activities.

There are tips for using SmartBoards, PowerPoint, and desktop publishing, as well as pros and cons for using ICT suites as opposed to class-based activities. For example, interactive whiteboards are seen to help the teacher remain involved in the class and better monitor student participation; in art and design, digital image manipulation software encourages student experimentation and allows less confident pupils to make more professional looking work, that in turn, gives them confidence to look for feedback. It is also suggested that software can enhance music students' understanding of notation and musical concepts.

The question of how to make the most of a single-computer class is again addressed here, in relation to specific subjects, and four main possibilities emerge: establishing a co-operative group station, where different topics are assigned to individual groups, each assigned a particular time slot; using it as a demonstration station, at which the teacher instructs the whole class simultaneously; assigning an independent research station; and using it as part of a learning centre, in which students are rotated around the class and use it for a particular activity.

The different stages of a given subject class are also analysed, in particular at the

primary level, and the best time to use ICTs is identified. Generally, in a one-hour primary class, in English, math and science, there is a 20-minute slot allocated for group work, which tends to lend itself best to technology-led activities. In addition, the final plenary session at the end is a good time to consolidate learning using a computer for whole class instruction.

Requirements for and barriers to effective ICT integration

One of the main themes in this section is, unsurprisingly, teacher professional development. Teachers who have been found to make effective use of ICTs tend to be those who demonstrate the following characteristics: They set high targets for their students with clear descriptions of the objectives and how ICTs will help them achieve those goals; they use a range of technological and assessment tools; they promote an effective learning environment that extends beyond the classroom to home-based study; and they are well-trained in practical integration of technology into classroom activities and not only basic computer functions.

Other requirements include a supportive infrastructure; quality contents and materials; enabling policies and strategies (including legal and ethical guidelines for use of ICTs); practice informed by evaluation and research; vision and leadership; student-centred approaches to learning; and relevant assessment tools.

Barriers tend to be divided into two groups: external and internal. External barriers include a lack of equipment, unreliability of hardware and inadequate technical support. Internal barriers often comprise school-level factors, such as lack of training (specifically in integrating technologies) and organizational culture, and teacher-level obstacles, including confidence and personal beliefs about the value of technology in their subject. In addition, obstacles also include problems of language, notably where English may not be widely spoken and, the range of educational software that can be used is limited, as well as a lack of educational software that can be modified according to the specific subject being taught.

There are also alternative reasons posited for the apparent under-use of computers in classrooms when compared to the prevalent use of ICTs in other spheres of modern working life: changing and contradictory advice from experts; the conditions specific to the teacher's working environment; and the exclusion of teachers from policy decisions concerning appropriate hardware and software for them and their students.

Evaluating effective technology integration

There are templates for evaluating your own or your school's use of technology here, as well as a host of suggested frameworks that take into account a range of learning goals and ICT functions.

One report identifies seven essential dimensions that must be assessed in order to gauge progress towards meaningful use of ICTs: learners, learning environment, professional competency, system capacity, community connection, technology capacity, and accountability.

Other steps to take include considering the goals of the ICT integration programme, the kinds of information you expect your evaluation to return, and what other stakeholders want to know. Key questions, such as whether student performance has increased as a result of the technology, should be seen as long-term issues, which should neither be ignored nor addressed too soon.

Alternatively, there is another framework suggested when evaluating ICT use. Six essential conditions are translated into measures of effectiveness: vision, practice, proficiency, equity, access, and systems. Each condition is presented with a number of indicators, which are then broken down into a series of components for closer analysis.

Case studies of successful ICT integration

There are case studies here that describe particular innovative uses of ICTs in schools around the world, as well as research findings based on such studies, into the common themes that point to good practice in ICT integration.

Many of these studies identify a range of characteristics exhibited by schools which have successfully interwoven ICTs into their curriculum. Common elements include good leadership; staff professional development; extensive curriculum planning; technical support, in the form of ICT co-ordinators and specialists; and strategic leadership, which includes vision, personal ICT use, and ability to manage change. One particular study identified four essential components for quality use of ICTs by teachers: prior experience in innovative programmes (not necessarily ICT-based), support from senior management, a collaborative working environment, and a willingness to take risks.

General findings from case studies reveal that strategies for using ICTs in the classroom are still evolving, while sustainability and improvement of provision are paramount for ongoing success. Recommendations include addressing the fact that, as students increasingly have access to computers at home, schools must address pupils' own innovative uses of ICTs. Further, flexibility in teaching practices is becoming increasingly important, as students need greater autonomy and more student-centred activities. Nonetheless, studies are suggesting that technology remains an additional resource that is vital in achieving standards-based learning goals, rather than taking centre stage.

As far as assessment is concerned, the case studies also reveal that there is still widespread uncertainty as to how to conduct meaningful student appraisals in the new climate of ICT-led learning, and a number of new models for doing so are emerging. Among these is the comparative model, that compares achievements in ICT and non-ICT based classes; the self-reflective method, in which students respond to questionnaires and staff then discuss these; and the public model, where schools bring in parents, the local community and the media for help assessing pedagogical progress.

There are also studies from South-East Asia that show how, with the backing of ministries of education and national and regional governments, in some countries ICTs have become institutionalized into the national curriculum, largely as a result of careful planning and policy reform that focuses explicitly on integrating ICTs into subject teaching. These policies tend to be characterized by a ground-up approach, beginning with widespread use at the primary level and slowly introducing ICTs into the curriculum at secondary schools and beyond. Again, this process can be led by national ministries of education or local governments. In Australia, for example, regional governments have been responsible for their own curriculum reform, and consequently, we can see different aspects of ICT in Education emphasized by each region.

SECTION 1

General Principles and Strategies for Integrating Technology in Education and the Curriculum

1. Dhanarajan, G. (2002) "Objectives and strategies for effective use of ICTs," in Haddad, W.D. and Draxler, A. (eds.) *Technologies for Education: Potential, Parameters and Prospects*. Paris: UNESCO and Washington DC: Academy for Educational Development.

http://www.unescobkk.org/fileadmin/user_upload/ict/e-books/TechEdBook.pdf (2 March 2005)

Type

Print publication/Online book

Abstract

This chapter looks at two questions central to the theme of ICT integration in schools: Policy and Strategy. The first question under policy, *How essential are ICTs to national goals?*, considers the driving forces behind the introduction of ICTs into education systems. The topics discussed include the many challenges facing education stakeholders around the world: the changing educational climate and new trends in the provision of education, the skills that tomorrow's work force will be expected to have acquired, and the emerging expectations of groups previously excluded from or overlooked by traditional education systems. The information explosion and illiteracy are also discussed in this section.

The second topic under policy asks, ICTs for what educational purpose? The report responds by describing four major education objectives that ICTs can help meet: expanding access to all levels of education, improving the quality of education, enhancing lifelong learning, and facilitating non-formal education.

In terms of strategy, the author notes that planning for ICTs in educational programmes tends to be informed by any of the following perceptions: a shift to a learner-centred approach to education, in which multimedia resources allow for self-paced and independent learning; a view of the teacher as a facilitator of learning drawing on a range of information sources; trust in technology's ability to offer greater efficiency and/or effectiveness of student learning; and ICTs' growing prevalence in society at large.

The many stakeholders in education must all be accounted for in strategic planning, aligning the learning strategy with those of libraries and information systems, academic management, student support systems, student administration, and others.

The author then identifies and responds to three essential questions that relate to ICT in Education: Which technologies? How will they be used? Will contentware be created or acquired?

Which technologies? The kinds of technology discussed that are available for teaching and learning range from low-cost tools, such as stand-alone PCs, to expensive networked classrooms. Specifically, the author looks at e-mail, presentational software, the Web, Multimedia (including CD-ROM and DVD), satellite broadcasting, and video conferencing, describing the strengths and weaknesses of each. The next question, *How will they be used?*, suggests these particular technologies are generally used in one or both of two ways: to enhance the richness and quality of education in schools, and to facilitate off-campus and distance learning that opens access to the quality resources available in the first case.

As for *contentware*, schools can do one of two things: design them, themselves, or in collaboration with partners, or purchase and adapt ready-made materials. The author identifies and describes the many advantages and problems associated with each choice. For example, creating content generally will call for at least a content expert and instructional designer, and very often audio and video producers, editors, ICT specialists, publishers and project managers - a diverse team calling for a working approach quite different from the normal academic environment. Questions to consider before purchasing materials, meanwhile, include:

- Does the product meet national and/or institutional objectives?
- Does the product contribute to the aims and objectives of the course?
- Is the content current, unbiased, and politically and socially sensitive?
- Is the use of text and media appropriate for the needs and objectives of the course?
- Can the product be used with locally available resources?
- Is it cost-effective to purchase the product?
- How well does the product fit the local learning environment?
- Does the product create barriers to learners (language, cost, technology)?

Excerpt

Technology strategy to support pedagogical approaches	Pedagogical approaches and examples	Technology infrastructure requirements
Using tools and templates	*Individual or group projects by students* -Course work preparation, building models, simulations, programming -Web page construction	-PC486 (non-multimedia) -Pentium multimedia -Stand-alone or networked -Individual ownership or provided on campus
Using models/simulations	*Individual self-paced learning* -Enhancing textbook and other resources -"Virtual" laboratories/ workbenches -Typically developed by publishers or consortia of university	-PC486 (non-multimedia) -Pentium multimedia -Stand-alone or networked; possibly accessed via Web (e.g., Java applets) -Individually owned PC, subject to ability to license individual copies; otherwise confined to campus-based PC workstations
Electronic mail	*Student-teacher and student-student communication* -Improved access to academic staff, submission of course work, feedback, advice, and discussion -Allows asynchronous dialogue	-PC486 (non-multimedia) -Connected to a network, accessible on-campus only or accessible from off-campus -University must maintain host mail server
Hypermedia resources	*Course resources for self-paced, self-directed learning or for private study directed by teacher* -Corpus of loosely structured documentation, including multimedia (sound, graphics, animation, and video) with embedded hypertext links -Can be made available on CD-ROM or via the Web	-Pentium multimedia PC -Stand-alone (CD-ROM) or networked (WWW)
Intelligent tutoring systems (ITS) (adaptive courseware)	*Self-paced learning* -Adaptive courseware extends the CBT/CAL approach by seeking to customize "lessons," based on dynamically modelling individual student performance	-PC486 (non-multimedia); ITS applications do not always require multimedia facilities -Pentium multimedia - stand-alone or networked, for courseware that makes use of multimedia - typically distributed on CD ROM -Use off-campus may be limited, depending on terms of copyright or site licensing

Keywords

ICT and curriculum; pedagogy; strategies/ policy; ICT integration

2. Fluck, A. (2001) "Some national and regional frameworks for integrating information and communication technology into school education." *Educational Technology & Society* Vol. 4, No. 3.

http://ifets.ieee.org/periodical/vol_3_2001/fluck.html (2 March 2005)

Type

Online report

Abstract

Based on interviews with policy makers, this paper describes ICT integration into classrooms in Australia, Canada, the United Kingdom and the United States, and several approaches to curriculum change at the national and regional levels.

In the UK, we read how the National Curriculum has gone through two revisions since its introduction in 1989, and each time the changes have reflected differing perceptions of ICTs and their place in the curriculum. Initially, students' learning in IT was to be assessed in a cross-curricular manner, with IT teachers expected to observe students applying their skills in other subjects. The impracticality of this led to IT becoming a subject in its own right, although this also was considered unsatisfactory because teachers found it hard to interpret the objectives that had been set for assessing students' skills and relate them to the classroom. For this reason, a set of comprehensive goals and standards were developed linking ICT skills to specific subject areas in the curriculum, allowing teachers to more easily see the connection between technology and subject teaching.

In the United States, meanwhile, a national approach to ICT integration was adopted with a private-sector teacher group, the International Society for Technology in Education (ISTE), which received government backing. Their project included developing a set of standards for students, including those for integrating ICTs into teaching and learning, as well as standards for technology support and tools for their assessment. However, state-run schools systems are not compelled to adopt these standards, and so implementation has proved erratic.

Australia has tended to follow a state-level policy for implementing ICTs in schools for learning and administration, and consequently, there tends to be a different emphasis among different regional governments. That said, there are signs that an increasing numbers of national projects are addressing benchmarks for professional development and computer literacy, especially for integrating technology into classroom practice.

Despite these differences, the author notes a number of areas that all countries had to consider to effect systemic change: ICT infrastructure, teacher professional development, and computer integration into each individual curriculum area. There are also clear similarities in the focus of ICT integration efforts – problem-solving, communication, researching and productivity/publishing are common themes in directing students' use of computers in learning, while independent learning and social/ethical concepts are found in some regions' efforts and not others.

The survey also points to three main phases for the introduction of ICTs in education: Phase 1, where students begin to use computers in schools and IT is a curriculum choice; Phase 2, where ICTs becomes a part of teaching practice across the curriculum to enhance learning; and Phase 3, where the curriculum includes elements that would not exist without ICT, and the traditional face-to-face model of education is no longer applicable.

The author notes that while most countries are at the second stage, there is some activity towards the third phase, and the question of the role of computers in home-based learning is becoming increasingly crucial.

Excerpt

Australia exhibits a wide range of stances towards the integration of information and communication technologies (ICTs) into

classroom practice. As each State and Territory implements its own strategic plan for using computers to improve administration and library systems, and to enhance the IT infrastructure in school, there is a possibility of divergence of philosophy and practice. In some ways each state emphasizes diferent areas in classroom use: Tasmania for desk-top publishing, Queensland for databases, Western Australia for tutorial packages, and so on. There are, however, some recent national projects emanating from the Federal Department of Education, Training and Youth Affairs that appear to be investigating national benchmarks for ICT literacy and teacher professional development for the integration of ICTs into classroom practice.

These glimpses into the processes of designing and implementing a national approach to the use of computers across the curriculum reflect the political contexts of the countries involved. However, it is instructive to quantify the time, energy and resources required to undertake such a process. Teachers have been acknowledged as crucial in the implementation stage, and basic computer skills training is only the tip of the iceberg in terms of their needs. These countries found they had to simultaneously address ICT infrastructure establishment, the training needs of teachers, and the issues of computer integration into every curriculum area as part of a coherent and linked set of systemic changes.

Keywords

ICT and curriculum; local education bodies; planning; policy/strategies; ICT integration

3. Jackson, L. (November 2003) "A beginner's guide to integrating technology." Education World.

http://www.educationworld.com/a_tech/tech/tech130.shtml (2 March 2005)

Type

Online article

Abstract

This article aims to equip educators who are new to using technology, whether trainee or veteran teacher, with the skills and know-how to bring ICT into their curriculum with confidence.

The article describes three stages in technology integration: a four-point 'STAR' approach (Student skills; Teacher skills; Access; and Resources) to assessing your technology readiness; tips for setting goals and planning how to meet them, including motivational ideas; and then a six-point framework for actual integration.

The first recommendation is to assess where you, your students and resources stand right now in terms of technology. What level of competence do the students have? Do they access computers at home? What about your own skills? What kind of access to computers do you have in the classroom? How many/often? What kinds of software/hardware can you access? Is there training available in your school/district?

Next up, the author suggests considering what you want to accomplish. This refers to your school's published plan, as well as your own personal goals. Following this, the article outlines a number of steps to help motivate you and inspire you with confidence: Get wired - this means getting Internet access at home; Get inspired - learn from colleagues and observe technology-enhanced classes in action; Get informed - visit a professional organization's website regularly; Get educated - subscribe to regular and relevant publications; Get involved - join teachers in online discussions (examples supplied); Get trained - find out who offers training locally, or takes courses online (examples supplied).

Excerpt

Enough motivation – it's time for integration! Take it one step at a time:

1. **Manage with technology:** Use technology to manage your classes. Average grades with a spreadsheet, use mail merge to send parent letters, and surf the Internet for lesson plans. Focus on using technology yourself before introducing it to your students.
2. **Start small:** Set an initial goal of including technology in one content area or unit a month. Have students write a letter with a word processing program, create a graph in

a spreadsheet program, or practice math skills using content software.

3. **Surf in shallow waters:** Surfing students misspell site addresses and become distracted by commercial sites. Focus class research by hand-picking relevant, age-appropriate websites. For help, check out 42eXplore or the Education World site reviews.
4. **Online learning tools:** Learn how to use WebQuests, scavenger hunts, and other online learning tools - and how to make your own - at Ed Index. (Click Online Learning Basics on the drop-down menu.)
5. **Test online:** Save instructional time and motivate your kids by creating, administering, and grading tests online. Check out the Education World article Motivate While You Integrate Technology: Online Assessment for more information.
6. **Know when to say no:** Technology isn't perfect; it can't replace face-to-face teaching. Learn to determine when technology helps - and hurts - the learning process and use it accordingly. Your curriculum, not your computer, should be the focus of technology integration.

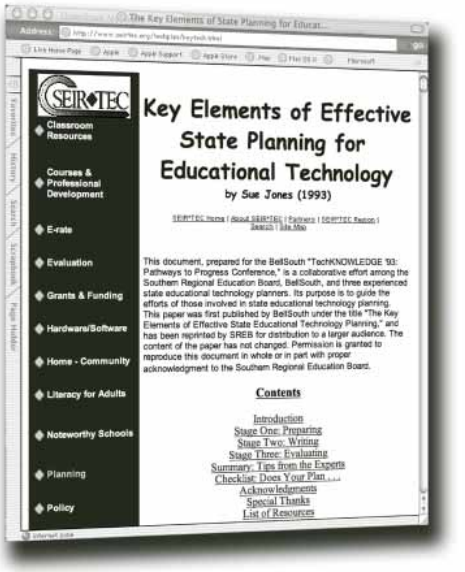
No matter what you know - or don't know - about technology, no matter how many computers you have, no matter how skilled your students are, you *can* integrate technology. Remain confident, flexible, and enthusiastic, and you will succeed.

Keywords

ICT and curriculum; policy/strategy; staff development; pedagogy; ICT integration

4. Jones, S. (1993) "Key elements of effective state planning for educational technology." *SEIR*TEC.*

http://www.seirtec.org/techplan/keytech.html (2 March 2005)



Type

Online article

Abstract

This document from the United States is intended to guide the efforts of those involved in educational technology planning at the state level in the US, although it will be of interest to stakeholders in any country. Recognizing that the individual principal and/or local authority will be better placed to decide what is best for a specific school, it aims to provoke discussion and identify questions – not to specifically define planning activities. Three experienced educational technology planners from the United States were asked to define the key components of educational technology planning, and their responses are presented under the headings: preparing; writing; and evaluating.

Preparing

Key aspects of this stage include:

- **Strategic Vision** - Bare in mind that technology's growing role in education is not understood by many public figures, and the success of your application depends on being able to communicate effectively how the new educational environment will look after the introduction of an ICT programme.
- **Goals and objectives** - What do you hope to accomplish? Consider financial and other constraints when preparing your educational technology plan. Unrealistic goals can lead to loss of support.
- **Needs assessment** - What is your state's current status? Consider your school districts' technological sophistication; how existing technologies are being used; the possible impact of state laws and mandates on your technology plan.
- **Scope** - What will your plan cover? Both instructional and administrative technology? Will schools be in charge of drafting their own technology plan? If so,

will you give guidelines? Will you define standards for old, as well as new, technologies?

- **Defining stakeholders** - When identifying stakeholders, consider the following three questions: Who has the power to accept or reject the plan? Who can influence public acceptance of the plan? Who can help gain support for the plan?
- **Organizational structure** - How will you organize those involved in the planning? There are many alternatives for the difficult task of organizing those assisting you. When designing the organizational structure, consider: How will you gain stakeholder input? How will you keep the structure non-partisan? How will individuals be selected, and what will their tasks be? What are the tasks you want to carry out? How will everyone's input be brought together?
- **Model schools** - In every state, some schools perform better than others, so the question is not whether to have model schools, but whether you will support them.
- **Funding** - How and when will the plan be funded? A schedule is vital to ensure that each stage is funded on time - failure to do so may derail the process and lose public support.
- **Equity** - Various definitions of equity are possible, depending on your state's focus. However it is conceived, it must be considered at the planning stage. Failure to do so may result in increasing, rather than bridging, the digital divide.
- **Staff development** - What kinds of training are needed for staff? Teachers must be made aware not only of how to use technology, but how it can transform their teaching practice. Expert suggestions include: train staff in their own building, on their own equipment, to meet their own needs; schedule training when technology is in place; make training continuous.
- **Consider** how to establish and maintain beneficial **relationships** with vendors and consultants**.** They can be very helpful sources of information; but before involving them, decide what you want them to do.

Writing

There are many approaches to writing a plan. The following are some of the main elements identified by experts:

- Vision - paint a picture for the public of how the classroom will look
- Mission statement - include an outline of challenges and intended actions
- Goals and objectives
- Strategy
- Scope
- Training and staff requirements
- Evaluation criteria
- Technical standards
- Cost estimates
- Timeline
- Glossary of terms
- Upgrading, maintenance and obsolescence strategies

Evaluating

- How will you judge the effectiveness of your plan?
- Keep evaluation regular - say, every 12 months; include a third-party person, for credibility; consider who can make any changes to the plan necessary to respond to changes in the educational environment; the evaluation criteria should be developed alongside your goals and objectives so that the public will know in advance what will be achieved; plan for data collection.

Excerpt

Tips from the Experts

- Be prepared when you face the legislature. (Know where you have been; where you plan to go; and what is happening in other states.)
- To further illustrate its potential, use technology to present your plan, but do not let technology become the focus of your presentation.
- Expect to make changes to your plan. (Build in flexibility and be prepared to make many tradeoffs before reaching your objectives.)
- Be creative when seeking solutions to problems.
- Consider all your options, not just the first or most apparent.
- Borrow from what has been done before. (For example, review the plans of other [countries] and take advantage of commercially developed planning instruments, etc.)
- Plan for unexpected developments. (Always be ready with a Plan B.)
- Use graphics to illustrate concepts in your plan.
- Showcase and build upon your successes.
- Involve all stakeholders as appropriate.
- Plan with the future in mind. (Rapid changes in the information industry may

require you to incorporate a completely new technology into the plan.)
- Use pilots only if you know you can be successful.
- Build training and funding into a realistic timeline.
- When beneficial, seek partners from industry and higher education.
- Present your plan to the legislature in segments if it has a better chance of approval than if presented as a whole. (Some states have had their entire educational technology initiative "wiped out" by the legislature because one element was not acceptable. If it had been presented in pieces, the other parts of the plan might have been approved.)
- Consider all sources of funding as resources for educational technology.
- Plan for maintenance and upgrading of obsolete equipment and materials.
- *Hint: Keeping higher education and industry involved in, or aware of, your plan can prove very helpful. This interaction could lead to collaborative efforts benefiting your state in the future. For example, working with colleges of education may help them better prepare future teachers to meet your state's expectations for teaching with technology.*

Keywords

local educational bodies; policy/strategy; planning; assessment; ICT integration

5. Maier, P. and Warren, A. (2000) *Integrating Technology in Learning and Teaching.* London: Kogan Page, 162 pp.

Type

Print publication

Abstract

This resource is aimed at academics and educators looking for new ideas and general guidance for using ICTs in their teaching practice.

Chapter 2, "Developing New Teaching Skills," describes how teaching can, and must adapt to the changing educational environment; helps you assess your own, your students' and your school's readiness to make use of ICTs in teaching; and discusses the pros and cons of the various multimedia resources available.

Chapter 3, "Designing Learning Environments," discusses how open learning materials can contribute to independent learning, offers a definition of open learning and describes how to plan and design resources for such learning environments.

Chapter 4, "Using Communication Technologies to Facilitate Learning," looks at the Internet as the ideal tool for communication and collaborative projects in higher education. The author describes techniques for structuring online discussions, provides guidelines for their facilitation and outlines other technological tools that can aid and support communication.

Throughout, there are references to other resources, including websites, for further reading and helpful tips. There are also case studies and activities that take the user through a series of reflective exercises to develop their pedagogical skills and guide their teaching preparation with a focus on embedding online communications within both existing and new courses. The book is also supported by a sister website, *www.clt.soton.ac.uk/activeguide.*

Excerpts

Chapter 2:

Three essential requirements for all users of ICTs:

> Access for staff and students to suitable computers. Suitability includes: specification; internet connection; and additional hardware and software (image scanner, digital camera, sound card, speakers, among others). Is student access limited to computer rooms that are often booked out ahead of class or that close at a certain time? Are computer rooms easily accessible (sometimes they may be off campus, out of the way, and poorly equipped, de-motivating students to use them)? Check that student computers can support the software you have been using to prepare materials on your teachers' computer.

Basic computer skills: ideally, everyone should be able to use email, surf the Web and use a word-processor.

Adequate technical support [pp. 35-6]
Procedures for putting programs and other resources onto a network
Your institution's computing service will have procedures for putting resources onto the network so that computing staff can maintain the system effectively, ensure that software is properly licensed and control viruses. There may also be procedures that regulate the material that is published on institutional websites so that standards can be maintained and copyright and legal issues checked. Check with your institution to find out about these procedures in plenty of time, since you may find that new software can only be installed on the public computers during infrequent scheduled upgrades. Do check this.

Time and know-how for you to do this
- Identify the resources you have in terms of text, images (photos, diagrams, pictures) and media (video, sound).
- Do you have to worry about copyright clearance?
- Do you know how to get these resources onto the computer? Can you get advice or help in finding the software and then learning how to use it? Check that you can run the chosen software on your computer.
- How much time do you think you will need? Is that feasible? Like so many jobs, digitizing resources always takes twice as long as you hoped!

Multimedia resource	Effort to create
Word-processed documents	
Presentations	
Digital images	
Graphics and clip-art	
Web pages	
Digital audio	
Digital video	
Simulations	
Key	
Simple technology, low effort	
Complex technology, high effort	

Creating multimedia resources [pp. 37-9]
Most disciplines have their specific IT 'tools of the trade,' such as a word processor, spreadsheet or statistics program. However, when we come to use 'computers in education,' we find we generally want to use them for *resources* and/or *communications*. So, when you want to consider using ICT in education, decide first if it is as a resource, for communication purposes, or a mixture of the two. In addition to this, of course, determine the specific IT tools used in your discipline...

We are not advocating that all teaching aids become digital, as seeing and touching the 'real' thing can be very important. However, many of our teaching aids can be digitized and stored on a computer. Once we have them there, we are free to use them in more flexible ways.

Whenever you make use of multimedia, always make sure that you are clear about the educational purpose it serves. There is nothing more irritating than waiting for a resource to download over the internet only to wonder at its relevance when it arrives. Remember that it also takes effort to create the resources in the first instance, so choose them carefully and create guidance notes to help students use them intelligently.

Checklist for Chapter 2 [pp. 59-60]:
1. Do you and your students meet the requirements covering computer access, skills and support outlined in Section 2.2?
2. If you want to use multimedia resources, have you searched to see if you can get these resources already in a digital format? You can try the subject-specific resource gateways on the Web, the Learning & Teaching Support Network in the UK, and relevant mailbases *(http://www.mailbase.ac.uk)*.
3. Do you know what to do with your resources once they are digitized - technically and pedagogically? How will you use this multimedia resource to enhance learning?
4. Have you checked copyright issues of using resources prepared by others?
5. Is the resource you want to digitize text, images, audio or video? Do you know which software packages you will need? Do you know how to do this, or can you get help?
6. If you go ahead on your own and get suitable software, have you checked that your institution can support you with this

software? Have you checked the licensing arrangement of any software you will use? Check that it is suitable for multiple users.

Chapter 4 [p. 111]:

Structuring online seminars

- **Rounds.** Students post an opinion or question by a certain date, and are given more time to prepare than they would have for the same kind of exercise in a face-to-face group.

- **Buzz groups.** Small-group discussions such as these are much better suited to face-to-face situations, as the emphasis is on quick communication to prepare for Q&A at the end of a lecture.

- **Syndicates.** Better suited to online discussions than 'pyramids' (pairs of students discuss a topic, then a group of four with another couple, then six and so on until they present to the whole group; the need for rapid feedback doesn't lend itself so well to online seminars). Sub-groups prepare a task together, in a private forum, before posting in a public forum for all students to access.

- **Fishbowls.** A small group of students enter into discussion on a given topic, while the rest of the group follows the debate by reading the messages, without actually joining in.

- **Organized debates.** These role-play debates can work very well online, where students can even be given a pseudonym as they argue from a certain position regardless of their own opinion.

Facilitating online groups

- Important interpersonal skills include: clear expression of ideas; enthusiasm; patience; and the ability to elicit participation.

- If possible, get everyone to meet ahead of online communication activities: Being able to put names to faces will help the discussion work.

- If meeting is not possible, consider one of the structured tasks, such as syndicates, to get everyone involved straight away.

- Using familiar names from traditional education environments helps to identify the kind of social interaction and level of formality expected. For example, labels such as 'seminar room,' 'office' and 'coffee bar' make it clear that each forum mirrors, respectively, the academic, organizational and social functions of face-to-face settings.

- At the beginning of online discussions, clearly set out the purpose of the discussion, its duration, milestones, expected outcomes and methods of assessment.

- Do not over-organize - flexibility throughout the course will be necessary.

- Invite an expert to join in for a few days, to reinvigorate any flagging enthusiasm.

- Begin with a non-crucial task, to allow time for ironing out any communication problems. For example, students can post a short introductory note about themselves, which confirms that everyone can access each others' messages and post their own.

- Keep a balance between informality and authority in your tone, and monitor the students' tone, too. It is easy to offend with ill-chosen attempts at humour.

- At the end of the period of discussion, post a message thanking everyone for their contributions, and letting them know what happens next. Also include a summary of the points covered and any conclusions reached.

- Consider at this stage a questionnaire asking for feedback on the students' experiences and technical issues.

Learning to learn online

It is not only tutors who are unfamiliar with what it is like to learn in an online group – many students will also find it a new and worrying experience. How does it work? What are they expected to do? How can they get the most from it? You should provide guidance on the social and learning skills that the students are expected to acquire – possible as part of an initial training session in the use of the software.

The ground rules for the forum should spell out such things as:

- **The standard of writing expected.** Is it formal and academic or relaxed and chatty? Should spelling errors be corrected or is it acceptable to 'typ quicly so long asits readable'?
- **The length of messages**. Online groups should be like a debate rather than a sequence of monologues, so essay-like messages should be discouraged unless that is what is specifically required.
- **The content of messages**. Should all messages remain 'on topic,' or is some social chit chat allowable?
- **The frequency of access.** Two or three times a week is realistic, although short burst of daily use may be possible.
- **Rules about behaviour.** These will typically forbid offensive, sexist or racist comments and insist that all criticism is positive and academic, never negative or personal.

On a deeper level, you should encourage all participants to post replies that take the debate forward instead of simply agreeing or disagreeing. Ideally, all participants should be leading each other towards a richer understanding of the topic under discussion. Skilled facilitators will lead the way by example, hoping that the students will adopt a similar approach as they gain in experience.

Keywords

ICT and curriculum; pedagogy; open learning; independent learning; ICT integration

6. March, T. (June 2001) "Working the Web for education: Theory and practice on integrating the Web for learning." *Ozline.com.*

http://ozline.com/learning/theory.html (2 March 2005)

Type

Online article

Abstract

This article considers what the Web can really offer the technology-rich classroom, and describes how, in the climate of "disintermediation," the teacher can take maximum advantage of the Internet.

First and foremost, the author suggests, the Internet is next to worthless as a learning aid without the teacher's guidance and co-ordination. The article then describes one detailed strategy for approaching the Internet as a means of enhancing student learning, accommodating both newcomers to the Web, as well as more seasoned, tech-savvy teachers. The two main phases in this strategy are:

- Harvesting the Web's abundance
- Shaping activities related to learning goals

This strategy then leads the teacher through a number of decisions that guides him/her to one of five different kinds of Web-based activities: Topic Hotlist; Multimedia Scrapbook; Treasure Hunt; Subject Sampler; WebQuest. The author includes a link to an example of these learning formats after describing each in more detail.

Topic Hotlist

A Topic Hotlist is effectively a web page that gathers together a collection of sites that you have bookmarked for their special relevance/interest to the subject you are teaching. This will save your students hours of wasted time searching, allows you to offer them a wide range of materials varying in scope and quality, and can easily supplement the activity they are working on, with tasks on handouts, for example. Depending on availability of resources and speed of Internet connection, students can even develop their own Topic Hotlist, and post it on the Web.

Multimedia Scrapbook

The Multimedia Scrapbook, rather like the Hotlist, consists of links to a variety of media, such as photos, sound clips, videos and virtual tours that students can access according to the aspects of a topic they wish to explore. They can then download or cut and paste these resources to be used in, for example, desktop slide presentations, bulletin boards or Web pages. While the Scrapbook does not aim to achieve specific learning goals in its own right, it can help achieve an open, student-centred, constructivist approach to learning in which students pursue their own interests.

Treasure Hunt

For more specific, targeted learning, the Treasure Hunt can offer a useful framework

for encouraging students to find, absorb and synthesize information. Students can be given, say, 10 to 15 web pages (the exact page, not the home page of a huge website), with one question for each page. Carefully-designed treasure hunts can allow students to gradually gather related pieces of information that enable them to build a cumulative picture of the topic being studied, and a well-formulated final task can help them synthesize all the information into a deep overall understanding of the subject.

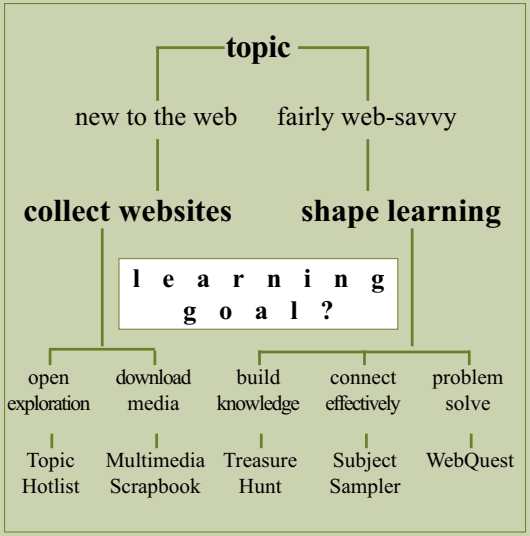
Subject Sampler

This kind of activity offers the student the chance to engage with a topic on a much more personal level. The Subject Sampler takes advantage of the host of one-off, idiosyncratic, or passionate material on the Web that has something specific to which the students might relate or respond. The teacher can then guide discussions that encourage students to interpret the material from their own perspectives, a process which emphasizes engagement with a topic, rather than the pursuit of right answers.

WebQuest

Increasingly popular among ICT-confident teachers, the WebQuest is an excellent way to promote higher-order thinking using the Internet for inquiry-based tasks. In groups, students explore contentious current issues or topics with at least two possible view points and exploit the wide variety of perspectives available on the Web to construct meaning around complex themes. Students gain a deep understanding of one particular perspective or aspect of an issue, and then come together to share their ideas, usually finishing with a task that allows them to synthesize all their information in some formal way, such as presenting their information to experts through the Internet.

Excerpt



Suggestions for Choosing Activity Formats

If you're new to the Web or think students merely need additional resources, gather links into a **Hotlist** or **Scrapbook**. If you're ready to take the next step of incorporating learning activities into a Webpage, then choose one of the three formats based upon what might be missing in your present curriculum. For example, if learners need to gain more knowledge about the subject, inform them with a **Treasure Hunt**. If they come out of a current unit apathetic, hook them with a **Subject Sampler**. If they learn enough knowledge and like the topic, but don't engage in higher-level thinking, challenge them with a **WebQuest**..

Now you may be saying, "Okay, I'm interested in making one of these Web pages, but I don't know HTML, haven't got a clue about how to post pages on the Internet, and mostly, I have no time to learn either." So the next question arises: **So do I give up?**

Fear not, feisty teachers, your life just got easier thanks to **Filamentality** ("combining filaments of the Web with learners' mentalities"). Filamentality is an interactive Web site that we created because learning HTML, designing a Web-based activity, and posting pages on the Net are three pretty big hurdles for people with students to see, papers to grade, lessons to write, and cookies to bake (the true glue that keeps a class happy). Thanks to masterful Perl programming by **Jodi Reed** (see her **Getting Started with CGI** Webpage) and the willingness of **Pacific Bell** to post user Web pages on its server, you can be guided through choosing a topic, gathering quality Internet sites, creating one or all five of the activity formats described above, and automatically posting your pages on the Web. Want to learn more? Test drive **Filamentality** on the Web or in a workshop near you.

Keywords

ICT and curriculum; pedagogy; classroom management; ICT integration

7. Mattingly, L. (Feb 1997) "Integrating technology in the classroom." Southern Indiana Education Centre.

http://www.siec.k12.in.us/~west/slides/integrate/sld001.htm (2 March 2005)

Type

Online slide show with notes

Abstract

These slides and accompanying notes, delivered as a presentation at a computer educators conference in the United States, chiefly look at ICT integration from a classroom management perspective. The slide show includes a number of useful tips for primary teachers on how to use computers in both low- and high-resource settings, particularly in literacy and mathematics classes, and offers guidelines for effective discipline techniques that encourage the students to take charge of their own self-discipline, freeing up the teacher to concentrate on teaching.

The presentation includes colour slides that describe effective class layout, based on a timed-rotation approach to using computers, with the different sections comprising: an area for student tables, for use during whole-class instruction; a library area; a computer area, where students work at their own pace on pre-prepared assignments; and a project area, often supervised by a parent volunteer. (The authors include such interesting suggestions as putting used tennis balls on the feet of the chairs, which reduces the noise when children are constantly rearranging the classroom as they move from one study area to another.)

There are also samples from the teacher's notebook of classroom set-up and lesson plans, to suggest ways to divide the class during two-hour lessons for language arts and mathematics, based on both five- and three-computer classes. The examples described of the various stages in the rotation sequence show how the computers contribute to student-centred activities and during project work, but do not dominate the students' working day. Some of the ways software is used in language arts classes include reading stories online, retelling stories in writing programs, and preparing and writing e-mails to partners at other schools. For mathematics, software is used that enables students to write stories that illustrate math problems and use spreadsheets to make a graph, for example, depicting the spread of the students' birthdays by month.

The presentation also includes a number of useful resources for extra support, and guidance for developing technology-rich lessons that include MapQuests and surfing for information.

Excerpts

This was a summer school project that involved kindergarten and first grade children. It is called "Surfing for ABCs". The Internet is another kind of learning tool. Children need time to discover how browsers work and what information they can find on the Internet. By beginning with a familiar concept (the alphabet) that needs little research or discovery on the children's part, the child can focus on learning how to use the Internet and navigate the Internet. Critical thinking skills as well as researching skills can be developed by using this simple approach on discovering the Internet.

If you visit this webpage, you can find the safety rules for using the Internet that the children learned while searching for sites that began with the alphabet using the Yahooligan's search engine. A lesson plan is included with this site.

Whether you have five computers, three, or even one computer in your classroom, we've found that:

- A centre's approach to teaching allows the most success for integrating the computer within your lesson plan.

- I like to put my children in heterogeneous groups.
- This allows me to appoint a student 'helper' for each group. If a student struggles while at a centre, they are to ask for help from someone within their group, rather than interrupting me.
- For a centre's approach to learning to be successful, good discipline within your classroom must be established.
- Training has been the key to our success.
- Training has helped us know our software. We've been able to develop lesson plans that integrate computer activities within our curriculum.
- For the last three years, each grade level has been given four to five days released time throughout each school year. Because our training is done by grade level, we can brainstorm together ways to correlate computer activities.

Keywords

classroom management; ICT and curriculum; assessment; discipline; primary; ICT integration

8. Shelley, B., et al. (2001) *Teachers Discovering Computers: Integrating Technology in the Classroom.* Cambridge: Course Technology.

http://www.scsite.com/tdc2/default.cfm (2 March 2005)

Type

Print publication/
Online book

Abstract

Aimed at student teachers, this book from the Shelly Cashman Series provides a broad introduction to computers as a teaching tool, and describes practical, pedagogically sound guidelines for integrating ICT resources and teaching techniques into the classroom. There is a sister website, at *www.scsite.com/tdc*, which offers additional information and resources, discussion topics at the end of each chapter and a guide to popular educational sites on the Web.

With a clear explanation of curriculum standards and their relation to benchmarks, the authors then emphasize that the curriculum must determine the kinds of technology used, not the other way round, and that relevant technology should be used to enhance learning at appropriate times. The relative advantages and disadvantages of centralized computer labs over individual classrooms are then described: Computer labs clearly are more cost-effective for the school administrators, and hardware is more easily maintained. They also usually connect to the Local Area Network (LAN), and are commonly used for students working through tutorial software and integrated learning systems software. However, there is evidence that computers and other technologies are more effective in the learning process when used at the point of instruction i.e. the classroom. In this case, teachers can readily access a range of resources, such as CD-ROMs or the Internet, to respond to students' questions as - and when - they arise: an occasion often referred to as 'a teachable moment.'

The chapter then describes the particular case of a teacher taking advantage of just such a teachable moment, with five student computers in the classroom allowing him to access the school's LAN and the Internet for a lesson on dinosaurs. Having anticipated the kinds of questions the students would throw at him, the teacher had researched, identified and evaluated a host of resources that allowed for a stimulating and interactive class. In addition to information available on the Internet, the students were also able to explore the websites of famous museums, and take virtual tours that brought to three-dimensional life a topic that had begun as a story about a dinosaur. The students then returned to their desks to write their own stories and describe what they had learnt.

Successfully integrating technology into the teaching-learning process requires that the teacher choose appropriate technology according to the learning goals of the lesson, and then develop ways to teach a group of learners with inevitably different learning styles.

For teachers to engage students more fully in the learning process, authentic learning experiences are recommended to motivate them. Specifically, teachers should ensure students are gathering, analysing and using information in situations that relate to real life. Similarly, teachers are urged to promote active learning, which enables students to be directly involved in the learning process and, therefore, feel ownership of the information with which they are presented. In addition, guidelines for improving the learning process through technology include anchored instruction, which provides students with a knowledge base on which to draw, especially important when learning about more abstract or less immediately comprehensible subjects, such as the human digestive system, which they cannot see or touch. Problem-based instruction then builds on this anchor or situation, and allows students to solve and understand more complex problems.

ICTs can help with all these types of learning. For example, multimedia educational software, such as *Body Works* for teaching all about the human body, allows students to experience things and concepts that textbooks could never offer. Furthermore, multimedia software taps into more of the ways that children – and adults – think: namely, in colours, sounds, and movement, and not just words and static pictures.

Planning for technology integration is also emphasized as a key component in effective use of ICTs for education. In addition to administrators providing training and mentor programmes for new teachers, planning obviously refers to the teachers, themselves, who must carefully assess where in the curriculum technology can most effectively enhance their students' learning experiences. Classroom management strategies must also be clearly thought through, and the physical layout of the classroom must be prepared according to the kinds and amount of hardware at your disposal.

Teachers must also consider the technological skills of the students when planning lessons that will entail students' use of tools such as computers and audio/video recorders. Skills assessment surveys can be helpful to identify the level of a student's abilities, and create a starting point for developing instructional strategies. A KWL (Know/Want to know/will Learn) chart is another helpful planning tool to assess student skills and knowledge levels. The authors also describe the ASSURE Model (**A**nalyze learners; **S**tate Objectives, **S**elect, modify, design Methods, Media, & Materials; **U**tilize Methods, Media, & Materials; **R**equire learner Participation, **E**valuate & Revise) for planning and delivering instruction that integrates ICTs into the teaching process.

Another tip is for teachers to turn their classroom into an integrated learning centre, which enables them to divide their classroom into many different types of learning environments in one space, and lends itself well to multi-task projects where students use different tools and class areas for different activities.

Excerpts

Chapter 6, "Education and Technology Integration," describes a number of outcomes readers will have achieved after completing the unit. They will be able to:

- Define curriculum and explain curriculum standards and benchmarks;
- Explain technology integration;
- Describe the use of computers in computer labs versus classroom instruction;
- Identify ways in which technology can positively influence learning;
- Identify ways to plan for technology integration;
- Explain various planning tools and instructional models;
- Describe the steps of the ASSURE Instructional Model;
- Identify ways to get started using technology at a new school;
- Describe the use of learning centres.

[Ch 6.8] The key to successful technology integration is identifying what you are trying to accomplish within your curriculum. First, you must consider what the learning goals and standards are, and then you must identify an appropriate technology tool that will help you accomplish your goals. While this process sounds simple, complete integration of technology in all subject areas is complex and takes a great deal of planning [...]
Once you have determined specific learning goals and objectives, and identified technologies appropriate for areas of the curriculum, you can then begin to develop innovative ways to teach a diverse population of learners with different learning styles. A

learning style refers to how individuals learn, including how they prefer to receive information, express themselves, and process information. Learning styles vary among individuals. For example, some people learn better alone, while others learn better in groups. Many different types of learning styles exist, and most individuals learn using a combination of several styles. The use of technologies such as multimedia and the Web can help address learning styles typically neglected by traditional teaching methods. By engaging students in different ways, technology encourages students to take a more active role in the learning process.

[Ch 6.13] Technology helps teachers promote active learning and create authentic learning experiences by allowing students to conduct Web-based research, explore concepts in a multimedia presentation, create a slide show for a history presentation, create a database of results from a group science project, and so on. Technology also provides opportunities for anchored instruction. Students can watch a Web-based video clip of a Himalayan mountain-climbing expedition, for example, and then move on to examine the history of Tibet, the Sherpa culture, the physical effects of climbing in high altitudes, or how avalanches start [...] Using discovery learning, you can break down classroom walls with technology, the Web, and most importantly – imagination. Properly integrated technology allows students to understand concepts clearer and learn no matter who or where they are.

[Ch 6.16] The best strategy for technology integration is to put the technology into the hands of trained teachers, make it easily accessible, and let them decide how best to use it in their classrooms at the point of instruction. Teachers then can use an array of teaching strategies to develop a learning environment in which students are encouraged to be independent learners and take responsibility for their own learning.

The main goal of such teaching strategies is to provide a consistent application of technology tools to support instructional curriculum areas. Also, it is important to give every student the opportunity to work with computers and related technologies. When proper strategies are used for technology integration, students enjoy learning to use technology, as well as the content in the subject-related curriculum areas.

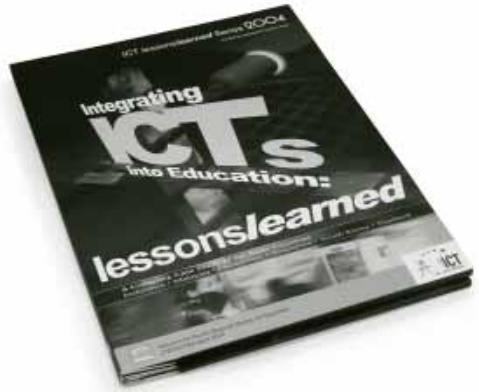
Already, many experienced educators are integrating technology into subject-related instruction – and have seen the benefits technology integration can bring to the learning experience. One critically important element in effective technology integration is continuous planning. Planning for technology integration must take place on many levels, including planning by the school district, planning for integration of technology in the classroom, and planning to integrate technology into your lesson plans.

Keywords

ICT and curriculum; pedagogy; ICT and interactive learning; independent learning; ICT integration

9. UNESCO. (2004) "Chapter 2: Policy and regulatory environment," *Integrating ICTs into Education: Lessons Learned.* Bangkok: Clung Wicha Press

http://www.unescobkk.org/index.php?id=1793
(2 March 2005)



Type

Print publication/Online book

Abstract

This chapter of a UNESCO publication describes policies for integrating ICTs into education as they have been put into practice in six countries in South-East Asia, each with broadly differing political and economic environments: Indonesia, Malaysia, Philippines, the Republic of Korea, Singapore and Thailand. The strengths and weaknesses of

these policies are then discussed under six themes: policy development; transforming ICT for education policy into action; legal and regulatory framework; macro-economic impact; inter-ministerial collaboration; and advocacy and obtaining support from policy makers and other stakeholders.

These themes are further discussed in terms of lessons learned, with specific examples drawn from the various countries. For example, under policy development, the first lesson is: 'To ensure that ICT in education policy in integrated into the national ICT policy, Ministries of Education should work closely with other government organizations, especially those in charge of implementing national policies in ICT and telecommunications.' In Indonesia, the Ministry of National Education worked with the Indonesian Internet Service Providers Association, telecom operators and private companies like CISCO to network over one thousand schools and provide Internet access to half a million high school students. In Singapore, meanwhile, secondary schools were restructured to include more technical training, such as mathematics and computer awareness, with the Ministry of Education working with the National Computer Board.

The second finding here is that pilot studies provide a good basis for implementing ICT into education policy. Pilot studies should involve formative and summative evaluations, and the policy ought to be able to refine the scope of the studies. In addition, it was found that ICTs can be implemented in education plans especially well when there are clearly defined roles and responsibilities for the relevant government ministries. This should include clear descriptions of project components, such as budget allocations and timetables.

Singapore is presented as an example of how a phased approach to implementation of an ICT policy can ensure the process is manageable, and also allow for the policy to be tweaked as evaluations provide useful lessons learnt. In particular, demonstration schools used in the first of these phases can act as models for integration in other schools, and allow teachers to observe best practices and share experiences. The less effective practice in Indonesia of individual departments within the National Ministry of Education developing ICT programmes in an isolated manner illustrates the advantages of a centralized system where the MOE supports the development of ICTs in Education. A national commission for this purpose may be responsible for establishing a strategic plan with a clear and measurable vision, planning the budgetary requirements, and developing and implementing clear regulations and guidelines on ICT use, from the national to school levels.

The legal and regulatory framework, the third theme under lessons learned, describes two common techniques for filtering the Internet and restricting access to unwanted websites: human analysis and software analysis. Singapore emphasizes public education and industry self-regulation, with an Internet Code of Practice that articulates the main areas considered offensive - namely pornography, violence and materials that undermine racial and religious harmony. In addition, there are clear obligations for Internet Service Providers to follow, and the three ISPs offer their own filtering services. The report notes that no filters are water-tight, while also warning against total supervision of children using the Internet, as this impedes their development of skills essential in modern society.

The recommendation, in response to the above, is to ensure education of Internet surfing issues becomes an integral part of parenting and teaching, at school and at home. This includes training teachers and parents to prepare them for this important supervisory role. Measures in the countries included in this report vary in terms of their responses to the threat of undesirable Internet sites. In Indonesia, for example, a private institution airs a programme called 'Healthy Internet', which provides information and guidance on, among other things, e-banking and opening attachments from unknown senders. In Thailand, meanwhile, there is still an absence of censorship regulation, and the recommendation is for teachers and parents to become more closely involved in guiding students.

The macro-economic impact of ICTs in Education centres on bridging the digital divide, and to this end it is recommended that government policy complement other initiatives in this area. In the Republic of Korea, for example, an initiative to promote equality of access involved providing PCs and financial support to poor families, led by the Ministry of Education and Human Resources Development, as well as awards to exceptional

students. In Malaysia, the Universal Service Provision Project provided over 200 schools with the necessary basic infrastructure to bring the Internet into schools, such as electricity, telephone lines and computers, and the project will be expanded into a national SchoolNet, to take in 10,000 schools in the country.

Inter-ministerial collaboration is identified as an essential component in integrating ICTs into schools, as it helps co-ordinate and harmonise implementation efforts. Examples include the Philippines, where the Department of Trade and Industry have worked with the Department of Education on a project called 'PCs for public schools.' The DTI secured the funding, while the DepEd selected participant schools and helped at the monitoring stage. Private-sector participation in inter-ministerial projects is also encouraged. Industry partners in Singapore have joined in the 'Adopt a School' project, developing a range of services for schools using Interactive Broadband Multimedia technologies, as well as providing training for teachers and students to use the relevant tools and providing technical support. Essentially, the recommendation is to link ICT in Education policy to national education objectives, to elicit more help from stakeholders and policy makers, and to improve communication with these stakeholders, especially in terms of making available recent research into the benefits of ICTs in Education, and sharing MOE steering committee decisions to involve stakeholders and develop a sense of involvement.

Excerpt

Based on the experiences of the six countries [...] the lessons learned are the following:

1. **Policy Development** (focus on pre-launch of an ICT in Education policy)
   - To ensure that ICT in Education policy is integrated in the national ICT policy, Ministries of Education (MOE) should work closely with other government organizations, especially those in charge of implementing national policies on ICT and telecommunications.
   - Lessons learned from pilot projects and studies in education that are carried out at different levels of the school system provide the basis for further policy expansion.
   - Harmonized implementation of ICT into education programmes can be achieved by defining clearly the roles and responsibilities of all departments (within the MOE and other relevant ministerial departments) in the implementation of ICT master plans, showing clearly the different components of project activities, including budget allocations, manpower requirements and timetables.
2. **Transforming Policy into Action**
   - Phased implementation of ICT in Education policy ensures that the implementation process is manageable and the development of best practices and lessons learned is gradual. It also provides opportunities for evaluations so that the policy can be revised and fine-tuned.
   - Central support from the MOE to pursue a clear and measurable vision helps in developing and implementing a comprehensive programme for the capacity-building of schools in using ICT.
3. **Legal and Regulatory Framework**
   - Initial filtering of the Internet from undesirable websites is necessary in order to prevent their harmful influence on younger students who may not be able to discern the veracity and reliability of information.
   - More than any software or hardware device, better protection is ensured by making education on safety issues pertaining to the Internet an integral part of parenting, teaching and learning activities at home and in the school.
4. **Macro-Economic Impact**
   - To narrow the digital divide, ICT in Education policy should complement other government initiatives, such as public education in ICT, donation of computers and provision of free Internet access.
5. **Inter-Ministerial Collaboration**
   - Sharing expertise, experiences and infrastructures among ministries and government agencies helps to coordinate and harmonise implementation of ICT in Education programmes.
   - Creating a national policymaking, regulatory and implementing agency for ICT development systematizes inter-ministerial cooperation on ICT in general, including education.

- Beyond ministries and government agencies, inter-ministerial collaborations could involve private sector participation.

6. **Advocacy and Obtaining Support from Policymakers and Other Stakeholders**
   - By linking the objectives of ICT in Education policy with national education objectives, support from policymakers and other MOE stakeholders, including human capacity-building, could be more forthcoming.
   - By making policymakers and stakeholders regularly aware of, and updated on, the benefits of ICT for education, advocacy for the acceptance of ICT use in education is further strengthened through research results and documentation of experiences.
   - By making all decisions taken or amended by the MOE's highest steering committee known to all members of the committee and heads of departments, their sense of ownership and involvement is enhanced.

Keywords

policy/strategy; planning; local educational bodies; government educational bodies; ICT integration

10. UNESCO. (2004) "Chapter 6: Curriculum, Pedagogy and Content Development," *Integrating ICTs into Education: Lessons Learned.* Bangkok: Clung Wicha Press

http://www.unescobkk.org/index.php?id=1793 (2 March 2005)

Type

Print publication/Online book

Abstract

Chapter 6 of this UNESCO publication looks at the context in which ICTs are being introduced into education in the six countries described. Generally, studies suggest that ICTs are not being fully incorporated into national curricula in the region, although recent policy changes have attempted to address that, and the lessons learned here provide a range of recommendations based on the perceived shortcomings and strengths of these countries.

Integrating technology into the curriculum is the first of six themes in this section, and the lessons emphasize the following four key points: teachers must understand that ICT can be used to achieve specific curricular goals; students must have the necessary computer skills if ICT is to be effectively used in the classroom; teachers play the key role in integrating ICTs into the curriculum; and when ICTs are introduced into the assessment process, that process itself must be reassessed.

Specifically, various ICT tools should complement each other and be designed in line with curriculum and pedagogical requirements. In Malaysia, ICT-based materials have been developed for teaching and learning in four main subject areas, in the form of courseware, teacher guides and sample lesson plans. They have been designed to allow for easy cross-curricular and intra-disciplinary integration. The ICT skills taught in these countries inevitably depends on the infrastructure available: those schools in Indonesia that have the facilities to do so teach ICT as a subject, and cover word processing and spreadsheets, Internet browsing techniques, and creative programs such as Photoshop, while high school graduates in Singapore will be expected to have acquired competencies in desktop publishing and online research skills. For teachers to lead the integration of ICT into the curriculum, it is recognised that they must be fully supported in a number of ways, including professional development, both formal and informal, and access to technology resources.

The second theme in this chapter concerns the shifting pedagogy that results from the use of ICTs. Firstly, it is noted that this is a time-consuming process. Use of ICTs clearly depends on basic infrastructure being in place, and many schools in a number of the countries described here lack the necessary conditions to begin to think about technology-enhanced instruction. The Republic of Korea offers an

example of how teaching and learning can be reoriented as a result of ICTs. Firstly, students are able to choose both the time and place of learning, as well as the activity they pursue, which results in more individualised learning. Secondly, knowledge is generated by each student, and both teacher and student roles change accordingly. Furthermore, in order to fully optimize the use of ICTs in schools, it is noted that shifting pedagogies and redesigning assessment must be accompanied by greater autonomy for each school.

Next up: content and services that support the improvement of curriculum and assessment. Local development of ICT resources is seen as crucial, and to this end, attracting international educational software developers to work with local companies is recommended. This can help create locally-relevant and authentic resources for both teachers and students. A second recommendation here is to establish a clearinghouse or digital library of ready-to-use, tailored resources to help teachers save time, and encourage them to become familiar with the benefits of ICTs in teaching. The Ministries of Education could also provide a list of recommended sites and software for particular subjects, again to save time, especially for novice teachers. For example, a digital library is a part of SchoolNet services in Thailand, which contains several thousand lesson plans in ten subject areas.

Evaluating content for political and cultural sensitivity, as well as reliability, is also essential. The Malaysian consortium for evaluating software includes teachers, teacher trainers and ministry officials, and their warranty for software runs for a year after the end of the pilot project, during which time any bugs or defects will be fixed.

Inevitably, English is the dominant language of much of the available educational software. While local-language software promotes the use of ICT in local schools, the widespread use of English as the lingua franca increases the need for students to have decent levels of competency in the language. Thus, countries such as Thailand are seen to be making moves towards upgrading students' English language skills to take greater advantage of the wealth of educational software available to bilingual students.

Finally, it is necessary to consider the financial implications of either purchasing the intellectual property rights to educational software, or buying a licence allowing for the perpetual use of those materials. In Malaysia, it was felt that the Government should acquire the property rights to the Smart School Integrated Solution and Applications Software, thus allowing all government schools to use it without having to pay fees.

Excerpt

Based on the experiences of the six countries with respect to curriculum, pedagogy and content development in the integration of ICT into education, the following are the lessons learned:

1. **Integrating Technology in the Curriculum and Assessment**
   - When teachers perceive ICT as a tool to meet curricular goals, they are more likely to integrate ICT into their lessons.
   - Equipping students with ICT skills facilitates the effective integration of ICT in schools.
   - Teachers play a pivotal role in the integration of ICT into school curriculum and assessment.
   - When ICT is introduced into the assessment process, there is a need to reconsider the assessment approaches.
2. **Shift in Pedagogy as a Result of Integrating ICT in the Curriculum**
   - Shifting pedagogical approaches to the use of ICT in Education is time-consuming.
   - Shifting pedagogies, redesigning the curriculum and assessment, and providing more autonomy to the schools help to optimize the use of ICT.
   - Shifting pedagogical approaches is facilitated through appropriate professional development of teachers.
3. **Contents and Services that Support Continuous Improvement of Curriculum Practices**
   - Attracting well-established foreign education software developers to work with local companies helps to develop high quality ICT-based resources.
   - Establishing a clearing house or digital libraries of ready-to-use and customizable ICT-based resources promotes better use of ICT in teaching, and facilitates quick and easy access to resources for making lesson plans and for teaching.

4. **Development and Selection of Culturally Sensitive Content**
   - Having a mechanism in place for evaluating content developed for schools ensures political and cultural validity, reliability and correctness.
5. **Ethical and Political Implications of Using English as Lingua Franca**
   - While local content in the local language promotes better use of ICT-based resources and materials, the use of English in schools optimizes the potential of ICT (especially the Internet) for teaching and for learning.
6. **Intellectual Property Rights Related to Educational Software**
   - A cost-benefit analysis conducted before deciding on whether to acquire the intellectual property rights to educational materials, or to acquire a perpetual license to use the materials, prevents waste of resources.

Keywords

ICT and curriculum; pedagogy; policy/ strategy; evaluation; ICT integration

Integrating Technology into the Classroom and Developing Lesson Plans that Integrate ICTs

1. Emans, B. (undated) "Guidelines for primary school teachers for integration of ICT in their lessons." Ecolenet.

http://www.ecolenet.nl/projects/guidelines_primary.html (2 March 2005)

Type

Online article

Abstract

This article is aimed at the teacher confronted with emerging technologies but with no experience in using them in the classroom. The author emphasizes the correlation between learning new skills oneself and feeling comfortable enough to integrate them in student activities. For example, the teacher can become familiar with using e-mail, and then confidently devise language-based tasks for the students where they send each other e-mails. Starting with simple technologies and activities, the teacher is encouraged to base his or her choice of ICT on its particular pedagogical function, rather than on the technical skills it may foster.

Children's development of ICT skills will automatically follow as a result of using technology in the class, especially when working together on collaborative projects. In addition, working collectively with ICTs on guided projects develops skills such as critical thinking, how to receive feedback, reading, writing and communication skills, and organization and planning strategies.

Finally, like so many discussions of the subject today, this article emphasizes the changing role of the teacher, as he or she moves from instructor to facilitator, by underlining the still vital, if re-oriented, role that teachers play in thestudent learning experience.

Excerpt

Overview of 6 principles

1. Do not be afraid

Computers might look difficult, but anyone can learn to master them. Any teacher can find ways to use ICT in the classroom, as long as they make sure they can cope with it.

2. Make a simple start

Start with very simple ICT-projects in your class. Only projects where you can solve

the problems will be a success. Later on, with more experience, your projects can become more complex.

3. Make combinations

ICT projects are not necessarily extra lessons in your curriculum. Think about making combinations with your normal lessons. This will give you better control of the project, and thus, it will increase the chance for success. Furthermore, it provides a back-up plan and might also save you time.

4. Focus on didactics, not technical aspects

Make sure that the use of ICT serves a didactical goal. Computers must not be used in the classroom because they are computers. They are used to improve the learning process.

5. Role of the teacher changes

Be aware of the changing role of the teacher. This role shifts from an instructor to other roles like mentor, coach, guide and motivator.

6. You are a learner, too

A teacher is a learner, too. Everyday, he/she will find new information, as well, especially when computers and the Internet are involved. Don't be afraid to admit to your pupils that you, too, have to learn.

Keywords

ICT in the classroom; staff development; pedagogy; ICT and curriculum; ICT integration

2. English, A. (2001) "Strategies to improve the effectiveness of Internet use by low ability pupils." Technology-integrated Pedagogical Strategies.

http://www.educ.cam.ac.uk/TiPS/aenglish.pdf (2 March 2005)

Type

Online report

Abstract

This is the report from a small-scale study into strategies for using the Internet to support low-ability students in a geography class in the UK. The methods of research included a student questionnaire, observations, diaries and group interviews. It generally found that students grew in confidence and competence throughout the duration on the course. Findings that need careful attention when planning to use the Internet as a learning resource include the following:

- These lower-ability students were less familiar with basic computer skills than more able pupils
- Some pupils said they were easily distracted by the mass of options on the Internet
- Students were frequently distracted by banners when using search engines, and others were often frustrated at not being able to easily find sites containing the required content
- The complexity of some websites added to the difficulties some students faced
- A portal page containing Internet links prepared by the teacher eased the students' difficulties, but resulted in some pupils feeling they were being helped too much
- Sometimes, students were asked to look out for keywords when searching online, which most felt helped them find the information they were seeking
- In addition, constantly being reminded to stay focused while using search engines seemed to help, but also tended to set a negative tone

Excerpt

The following points are based on evidence collected by interviews and the observations by the teacher and assistant:

- The interviews and questionnaires suggest that the pupils in low ability groups have less access to computers and the Internet at

home than pupils in higher ability groups, and so they may be less confident and competent when using them at school.
- Pupils quickly developed skills such as cutting and pasting text and photographs from web pages into their own word processed documents.
- Pupils identified the problem that text on web pages is often difficult to read for the following reasons: small text size, long sentences stretching across the screen, difficult vocabulary and the text being set against a strongly coloured or patterned background.
- Pupils reported that they found difficult sections of text easier to read when they cut and pasted the words onto a plain background and made the text larger and the width of text narrower using word processing software
- Pupils in low ability groups reported that they were confused by the complexity and wide range of options offered by some web pages. However, strategies can be developed to help them to focus on the search for key words on the page, without being distracted by links and information which will not help them with their task.
- Pupils reported that their behaviour is better in the ICT suites than in the classroom. This seemed to be supported by observation by the teacher and other independent adults.

Keywords
ICT in the classroom; special educational needs; pedagogy; ICT integration

3. Grosse Pointe Public Schools. (May 2004) "Strategies for integrating technology into your curriculum." Grosse Pointe Public School System.

http://www.gp.k12.mi.us/ci/ce/computer/strategies.htm (2 March 2005)

Type
Online article

Abstract
These tips are aimed at K-12 teachers, and focus on technology-led projects for students. The Grosse Pointe schools system has developed a range of useful materials and sites of their own, as well as linking to external sites, that provide ideas for bringing technology into the classroom in ways that harness the potential of ICTs for independent, project-based learning. There are sites that can connect students to experts in a given field, thus opening them up to real-life feedback and meaningful communication experiences; perform research using the Internet as a resource for retrieving, analysing and processing information; collaborate with other students and post their work on the Net; and engage in multimedia projects, which allow for a multi-disciplinary approach to learning, as projects take in elements of, say, mathematics, language arts, geography and technology all at the same time.

Excerpt
The page lists 10 ideas for ICT-based activities, and provides external links for further information, examples and resources. The ideas include:

- Using the Internet to conduct research, and collect and analyze information. Students can develop higher-order thinking skills if you lay out a plan for how the information they retrieve can be used.
- Expand students' horizons by connecting them to experts, at one of various "Ask-an-Expert" sites. This is a great way of supplementing the curriculum with authentic and current information, and shows how ICTs can be used for valuable communication and information gathering.
- Use the Web to display tutorials and online lessons, e.g. the Grosse Pointe tutorial page contains a range of lessons, from basic word processing packages to specific programs such as PowerPoint and Photoshop.
- Publish projects on the Web. CyberKids, for example, has a page that contains poems, stories, art and other creative work that can inspire students and teachers, alike.
- Use e-mail and the Web for discussion, in forums, or to distribute ideas.
- Join in collaborative projects to encourage students to communicate and co-operate with other pupils from other schools and regions.
- Harness the multimedia potential of the Web by bringing pictures, animation, sound and databases into your teaching.

Combine Project-Based or Problem-Based Learning with Multimedia
In project-based learning, students participate in collaborative projects and experience an interdisciplinary blend of skills from math, language arts, fine arts, geography, science, and technology. Project-based learning has the potential to increase students' feelings of responsibility for, and control over, their own learning. Students who are allowed to define their own learning goals will be more engaged in learning.

[The following external link describes strategies for planning project-based learning: *Project-based learning with multimedia*: *http://pblmm.k12.ca.us/PBLGuide/Guide/Steps.html]*

1. **Decide on the project**
   May include: Identifying what content will be incorporated, identifying any constraints, deciding on multimedia component, deciding on scope of project, looking over PBL+MM components and deciding on major goals of project

2. **Draft time frame**
   May include: Deciding on length of project, writing down some due dates or checkpoints for project goals to be completed, allow room for flexibility, growth, and changes in project

3. **Plan activities**
   May include: Browsing the Challenge 2000 Website for appropriate activities, selecting a few, adapting a few, drawing on own activities, borrowing and adapting other teachers' ideas, deciding when in project time frame to use activities

4. **Plan for assessment**
   May include: Reviewing or drafting some assessment goals (answering the question of what to assess), planning out what assessment tools to use, adding assessments to time frame

5. **Begin project with students**
   May include: Discussing goals with class, allowing for flexibility, keeping eyes and ears open for what is working and what is not, remembering to give students time to get the swing of new practices, adding activities or backtracking to strengthen group skills or management skills, sticking to original time frame or discussing and planning out any revisions to it. Students may also contribute to some of the initial planning of the project

6. **Finish project and reflect**
   May include: Presenting finished product in a special forum, discussing or writing about highlights of project, discussing or writing about suggested improvements for next time, taking time to write down personal reflections on project and things to remember for next time

Keywords
ICT in the classroom; independent learning; ICT and curriculum; pedagogy; ICT integration

4. Higgins, S., et al. (1999) *500 ICT Tips for Primary Teachers*. London: Kogan Page, 200 pp.

Type
Print publication. For orders, contact: Kogan Page, 120 Pentonville Road, London, N1 9JN, UK. Tel: +44 (0)20 7278 0433 Fax: +44 (0)20 7837 6348; E-mail: kpinfo@kogan-page.co.uk (General Information); orders@kogan-page.co.uk (Orders)

Abstract
500 ICT Tips for Primary Teachers is aimed at primary classroom teachers, IT co-ordinators and school managers, and will also be of use to parents and trainee teachers. The book contains a rich selection of guidelines and advice on how to make the most of ICTs all curriculum for the primary school classroom. Topics include practical advice on using hardware and software in the classroom, treating ICT as a discrete subject, integrating ICTs into specific subjects, and accessing and organizing resources, among many others.

In particular, Chapter 3, "IT as a Cross-curricular Subject," offers useful tips for using ICTs in language, maths, science and foundation subjects. The chapter opens with a set of general guidelines for organizing IT in other curriculum areas, to emphasize the need for flexibility and open-mindedness when setting learning goals. There are also practical tips that the new teacher may easily overlook.

For example, it recommends considering whether headphones will be a necessary accessory to limit disruption to and from other activities taking place at the same time, and being prepared to re-organize the classroom, particularly computers, according to the subject being taught. In addition, there are pedagogical tips, such as using a computer as a teaching aid, rather than assuming students can only benefit from direct access to computers. Where access to hardware is limited, there is the option of using a floor robot as a demonstration aid, and then getting the children to work on set tasks with pencil and paper. Further general tips include considering who else may be available to help out, such as students, auxiliaries or parents, and what other spaces may be more appropriate for technology-infused classes.

Under language, the authors draw attention to the possibilities for using various media, including video and radio, for activities with both younger and older students. For example, more able students can use news reports and the Internet for developing higher-order research and creative writing skills, while less advanced students may find recording ideas for stories onto tape helpful for maintaining focus during the writing stage. emphasizing the role ICTs can play in listening and talking exercises the authors suggest using video or audio recorders to tape news bulletins or plays prepared by the students to enhance role play activities. They also remind the reader that word processors can be used for a great deal more tasks than typing out documents - they recommend using clip art and decorative borders to brighten up creative writing, and point out their use in drafting and identifying spelling and grammar mistakes.

Floor robots are recommended for use in math classes with both younger and older children, as they can be easily adapted to the level of the students using them, and allow for a range of problem-solving and investigation activities. In addressing the problem of some children dominating ICT-based math activities, the authors suggest getting the class to individually record when they use specific programs, and how far they get with them, which in turn will help the teacher keep track of who needs help in which areas. It is also suggested that a less conspicuous role be played by the teacher when using ICT-based resources, and that peer tutoring be encouraged.

Despite science lessons being slightly more limited in the ways they can involve practical investigation work, nonetheless CD-ROMs that contain databases can be used to set up stimulating exploration activities, while even young children can collect and classify information on a computer screen, or use a picture-based concept keyboard. ICTs can also offer more engaging ways for students to record and report scientific investigations; videos and cameras, for example, can be very effective in turning boring reporting into a creative process and in stimulating fuller participation in discussion activities. On a practical note, the authors recommend certain activities, such as data logging, be organized in groups of around 10 students, ensuring each child can see the screen and, therefore, remain fully involved.

Tips for using ICTs in foundation subjects include using resources that allow for comparison exercises, for example educational software containing photos of varying geographical landscapes; finding historical simulations that allow children to become more personally involved in their subject; acquiring an easy-to-use paint program that allows children to experiment, as well as to use for desktop publishing; and taking advantage of time-saving clip-art, which can stimulate written work. Furthermore, setting up a class database is recommended for helping children become accustomed to research and reference work, and they will also develop skills for storing, sorting and classifying information.

Excerpts

The following are some sample guidelines from this chapter:

[General] Be prepared for a bit of upheaval. Because ICT can be used throughout the curriculum, it may be appropriate to move resources around, especially if you have a classroom organized into learning areas. There is little point in having a computer in the language area while it is being used for a science investigation.

Ask for it! In our experience, IT co-ordinators can feel very isolated when it comes to steering their curriculum area. Many would be only too delighted to have someone else making a few suggestions. If you feel you are missing an opportunity, why not ask to have a look through the huge pile of free catalogues your co-ordinator is bound to have stashed away. (It might be wise, however, to check that you aren't about to spend a budget that has already been spoken for.)

[ICT in language] Try to identify a couple of programs that best suit your needs. It is unrealistic, and possibly counterproductive, to try to use too many different programs. To get the best from them, you need to put in time and effort...Give your class time to come to grips with programs, making sure everyone gets a go. Then try to make it available so that the pupils get the chance to extend and consolidate what they have learnt. They can't do this if there are too many programs to choose from.

Try to get the best out of what you have got. Concept keyboards, for instance, are incredibly versatile. They can be used for very early literacy skills in nursery and reception, where simple sentences can be built up using sight vocabulary and picture clues. They can provide sources of information in, say, history work, where pressing a picture of an artefact presents information about that artefact on the screen. They can be a way of communicating information, where the children design overlays and program the computer to present their ideas to others.

Use word processors to their full potential. Obviously, word processors are useful for presenting written work neatly, but, if used well, can do a lot more besides. Pages can be set up that act as a stimulus for written work. A piece of clip art or decorative border that may help inspire creative written work can be prepared in advance. They are perfect for drafting, editing and redrafting work because making alterations is so easy. They often contain spell checkers and the clarity of the text can make identifying errors much easier. They are too expensive to be used just as typewriters, so try to use their full potential!

[Maths] Try to get one generic math program that may be used throughout the year. You will probably need a package that allows you to work on data handling and perhaps spreadsheet work, and a LOGO package can be very useful. As with all generic programs, try to get one that suits your age group and stick to it; as the children's familiarity with the program develops, so does their ability to use it independently. If possible, try to get one that is used throughout your key stage to promote this aim.

Keep the number of drill and practice programs to a minimum. To get the best out of a program, it is usually better to keep it around for a while. If you organize it so that each child has a go and then never sees it again, you are missing out on one of the best motivational factors – trying to get a higher score than last time! Watch children (and adults!) using computer games to remind yourself how addictive this factor can be.

Look out for effective support packs. Many simulated adventures come with resource or activity packs, i.e. collections of worksheets that go along with a piece of software. Sometimes they provide good support materials, with work that you can do away from the computer, but often they are to be used alongside the computer. If you only have one machine in your classroom, using these materials can become a logistical nightmare.

Do not underestimate the power of peer tutoring. Children working in pairs on mathematical tasks teach each other very effectively. Just try sitting and listening to the quality of discussion and co-operation going on between two children trying to solve a mathematical problem using a floor robot if you want proof! Often, when using ICT-based resources, less (of you) is more! Sometimes, very little teacher input is required. Also, the 'expert/apprentice' model of working for disseminating knowledge, understanding and strategies, can work very well in these contexts.

[Science] Don't expect to be able to do it all at once. If your school is well resourced, the possibilities and opportunities you will be able to offer may be very different. It takes a lot of time and effort both to come to grips with new resources and to integrate them into your teaching. Over time, you will be able to incorporate them more into your work, but don't try to do it all at once.

Remember that databases can be an excellent place to start investigating. There are many aspects of science work that do not lend themselves to practical investigations, but databases on CD-ROM can still offer potential for exploration. For instance, if you were to discuss the differences between amphibians and reptiles, searching a database and noting characteristics of each could provide a stimulus for a great deal of debate and further investigation.

Remember that modelling can be a valuable, but complex, process. In theory, computers are perfect for modelling events and trying out possibilities. In practice this is true, but they neglect to tell you that setting up reasonable models, and making it clear what these models are supposed to represent, can be really tough. You will find that it is much

easier to stick to published software, unless you are a bit of a whiz!

[Foundation subjects] Get a good, easy-to-use paint program. A good paint program can be worth its storage space in gold. While it can allow children to put together illustrations for desktop publishing activities and so on, it can also be used to work in a way that can be too frustrating when done in a traditional approach. While many simple paint packages are a bit crude, they do allow children to experiment. This allows you to claim with justice that you are using computers to model situations. Illustrating work in different curriculum areas with the same program will develop key ICT skills and support different subjects.

Find suitable sites on the Web. If you have access to it, it is amazing how many libraries and museums have websites. Just looking at one with a small group of children could open up many new avenues of study. Not only will it give access to new and previously unobtainable sources of information, but it will give children new ideas about how they might organize and present their own work in future.

Keywords

ICT in the classroom; pedagogy; ICT and curriculum; primary; ICT integration

5. Hoerr, T. (July 2002) "Technology and multiple intelligences." New Horizons for Learning.

http://www.newhorizons.org/strategies/mi/hoerr.htm (2 March 2005)


Technology And MI

by Thomas R. Hoerr, Ph.D.

Looking ahead to how ICTs will inevitably become embedded in classroom teaching in the near future, the author describes a number of strategies tested at his own school in the United States. For example, one suggestion is to get students to turn their research on famous figures from history into living people, by dressing up and acting out the lives of their heroes and heroines. These can then be recorded and used in the future, providing a stimulating source of information that later classes will learn from and be inspired by for their own research.

Type

Online article

Abstract

This article observes that there is a conspicuous gulf between the ways that technology has impacted on our daily lives and the ways that it has affected classroom teaching. Somebody waking after a fifty year sleep, the author suggests, would be shocked by the technological tools taken for granted in our working and home lives, while the same person would notice very little difference in our school systems. Notwithstanding the prominent positions computers occupy in many schools, the nature of instruction is very much the same as it was fifty years ago.

Excerpt

Use videotapes as a tool for student reflection and developing the intrapersonal intelligence. We believe that the personal intelligences are the most important ones, and videotapes can be a powerful tool to give students feedback about themselves. We use videotapes at every grade level to tape students as they present their research projects and reports. We also have created forms which the students complete while watching themselves on tape, in order to reflect on their performance. Watching oneself presenting on videotape and responding to questions such as *What did you do well? With what were you not pleased? What should you do differently next time?* is a real learning experience. Students not only learn how to share information and

present their findings and opinions, they develop their intrapersonal intelligence.

Use CD-ROMs to create digital portfolios. We are beginning to talk about this as an alternative to our traditional portfolios. Filled with papers and photos, along with an audio and videotape, our present student portfolios address every intelligence each year and are over-brimming by the time a student completes the sixth grade (despite the fact that we cull them each year). A digital portfolio would not only save space, it would facilitate sharing student progress with families at home and around the dinner table (although we would never want to forsake our spring Portfolio Night). Of course, a digital portfolio would not only be able to contain far more information, technology would capture a far richer picture of a child's progress, showing him/her "in action" while making presentations.

Use digital camera technology as part of report cards. Last year it dawned on me that is was fairly ludicrous that we at New City, an MI school, relied almost exclusively on the linguistic intelligence to share student progress on our report cards. Our twice-annual report cards - 5 to 9 pages in length and beginning with a page devoted to the personal intelligences - consisted of skill-based grids, rubrics, and personalized narratives. Last year, instead of simply writing about a student's progress in art class, we also used a digital camera to include a photo of a piece of the student's art work in the report card. This year, rather than simply describing a student's efforts in creating a Native American diorama, we also added a picture of the student holding his/her diorama. As with the photo of the child's art work, discussion questions are printed at the bottom of each page to facilitate a dialogue among parents and students. Next year, we plan to expand this strategy to more grades, with digital photos ultimately being an integral part of every report card.

A non-New City idea is to look for software that supports the intelligences not most readily available in your classroom. None of us is strong in every intelligence, and it's only natural that we tend to teach in those areas in which we are the strongest. Learning-centres can be used to help address our weaker intelligences, and software can supplement them. Learning arcades designed around each intelligence, moving from room to room, have been effective at the Truman School in Davenport, IA.

Keywords

ICT in the classroom; multiple intelligences; pedagogy; ICT integration

6. Hungerford, C. (February 1998). "Using CD-ROMs effectively in the classroom." techLEARNING.

http://www.techlearning.com/db_area/archives/WCE/archives/hungerfo.htm (2 March 2005)

Type

Online article

Abstract

This article describes ideas for getting the most out of educational CD-ROMs, and draws on the author's experiences teaching a science class on teenage pregnancy, using a CD called 'nine-month miracle'.

Sensing that the CD had greater potential than students were getting out of it, the teacher developed a detailed course outline to accompany the software, which is described in this article. Activity sheets accompany the CD, which contains QuickTime movies, pictures

and animation, and the teacher has also attached a pregnancy website that shows young mothers what is happening to their bodies on a monthly basis.

The author also describes four off-computer activities to accompany the CD-based course outline:

First, the students use the Internet to develop posters that show the harm that smoking, alcohol and drugs can cause to an unborn baby, which is then put up around the school.

Next, students write an article for the school magazine explaining the value of exercise to pregnant mothers. Again, they use the Internet for research before completing the task away from the computer.

They then write a letter from the point of view of a mother or father of a pregnant child, describing the pros and cons of abortion or adoption.

Finally, the students research how a particular chemical can harm an unborn child, story-board the findings, and then film a public service announcement for their local cable channel.

After these activities, the teacher conducts an Internet scavenger hunt. With very little guidance, the students must find specific information from a selection of websites supplied by the teacher.

There is then an exercise revealing the support needed for teenage parents to succeed. Finally, students take home a baby simulator, Baby Think Its Over, for three days. The program responds to neglect and abuse, and must be 'fed' regularly. The students then write a report describing their experiences with the simulator.

Excerpt

Some may argue that all the computer stuff isn't needed – students could learn this out of a textbook. However, they wouldn't get to see the wonderful animation of the baby developing [in the Nine-Month Miracle CD]. Most of our students prefer the multimedia method of learning. It's easy for them to pick up where they left off the day before, as they can go to any month of the pregnancy without having to start from scratch. I would call 9MM a marriage between the TV and the textbook in that it provides video to watch and plenty of information.

Here are some tips for others wanting to incorporate CD-ROM and the Internet into the classroom:

1. Research CD-ROMs *before* you buy them. Ask for a demo version from the company, ask other teachers and read reviews in computer magazines, or search on the Internet. Don't waste precious money; buy only the best.

2. Once you have purchased a CD-ROM, sit down and go through the whole thing. This may take several days or more. You need to know what is on the CD and what you can do with it. This will also allow you to guide your students through it when they get stuck or have a problem.

3. Don't feel that the CD-ROM is your only source of information. Text books are OK! The Internet has tons of information, and so does your library. Expose your students to all forms of information gathering.

4. Create off-computer projects. After a while, students may get tired of sitting in front of the computer. Give them some activities to do where they can get up and move around and use their hands more than just operating a keyboard and mouse.

5. CD-ROM encyclopedias (Encarta or Groliers) can be fun for scavenger hunts besides just looking for information. Be creative.

6. If you only have one computer, use it in front of the class so everyone can participate. If you have students work on the computer one at a time, make sure that the student who isn't doing so well in your class gets on the computer. It may turn on that 'not so good' student and get them interested in learning.

7. Look for CDs that allow you to set the pace of the material to the speed of the learner. 9MM allows you to slow down the presentation of information or speed it up depending on the student.

Keywords

Educational software; science; ICT in the classroom; pedagogy; ICT integration

7. Intel®. "How to set up computers in your classroom." Intel® Innovation in Education.

http://www.intel.com/education/newtotech/class_setup.htm (2 March 2005)

Type

Online article

Abstract

There is a lot more to setting up computers in the classroom than simply thinking about where to put them, as this article from Intel explains; indeed, that question alone involves a lot of thought. The first thing the teacher should consider is how you are most likely to use your computer: as a presentation station, from which to lead the class or allow students to do so; as a learning centre, where students work alone or in small groups on project-based assignments; or primarily as a teacher work station, working mainly on administrative tasks.

Following that, the article describes a large number of tips on how best to organize and facilitate learning according to whether you have a single- or multiple-computer classroom. The author also includes some guidelines for accessing and creating support groups. In addition to whatever level of technical support the school enjoys, it recommends setting up a network of colleagues, and more interestingly, students, who often spend hours on computers and are far more adept than many teachers.

Excerpt

If you have one computer...

- Pick a home base for your computer depending on how you expect to use it most often. Remember that you'll need access to electrical outlets and, if available, your phone or cable line.
- If possible, keep your computer on a sturdy mobile cart so you can move it around the room. As you and your students develop more expertise, you'll probably use the computer in a greater variety of ways. For example, even if you initially use it as a student workstation, plan ahead so you can move it to the front of the room to use as a presentation tool.
- Make sure the height of your computer station is appropriate. The monitor should be eye-level and the keyboard elbow-high. Use a mouse pad so the mouse rolls easily and stays clean.
- Plug all the cables into a single power strip equipped with a surge protector. Not all surge protectors are the same, so be sure you get a good one. Better yet, have your district install commercial surge protection on the circuit box.
- Protect younger children by covering unused outlets with plug caps.

If you have several computers...

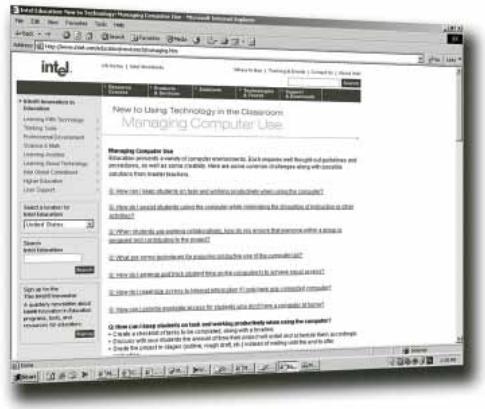
- Set up one computer as a shared presentation/ teacher workstation in the front of the room.
- Use the rest of the computers as student workstations. Most teachers form a computer cluster in one area of the room, usually towards the back where they're less apt to cause a distraction.
- If you end up with a jumble of wires, colour-code each set and the associated computer with stickers. That way you can identify cables when you need to troubleshoot or move equipment.
- Tuck wires out of the way. You may want to consolidate them with one or more "cord snakes," hollow plastic tubes designed for this purpose.
- Adapt your mini-lab to your needs. Students sometimes work on the same activity, but other times you may want to designate a different role for each computer. One station can be a reading centre with a collection of electronic books, another a writing centre with a word processor and publishing tools. Add a maths/science centre, a social studies centre, or a music and art centre.

Keywords

ICT in the classroom; classroom management; hardware; ICT integration

8. Intel®. "Managing computer use in the classroom." Intel® Innovation in Education.

http://www.intel.com/education/newtotech/managing.htm (2 March 2005)



Type

Online article

Abstract

There are a large number of responses here to some frequently asked questions by teachers coping with single-computer classrooms. The following questions are addressed:

- How can I keep students on task and working productively when using the computer?
- How do I assist students using the computer while minimizing the disruption of instruction or other activities?
- When students are working collaboratively, how do you ensure that everyone within a group is engaged and contributing to the project?
- What are some techniques for ensuring productive use of the computer lab?
- How do I arrange and track student time on the computer(s) to achieve equal access?
- How do I maximize access to Internet information if I only have one connected computer?
- How can I provide equitable access for students who don't have a computer at home?

Excerpt

Q: How do I assist students using the computer while minimizing the disruption of instruction or other activities?

- Train student experts to assist others on the computer(s).
- Use objects to communicate when help is needed.

  Examples:
  - Place flags on the computers or monitors. Yellow indicates help is needed, but the student can continue to work. A red flag signals an urgent issue, which prevents the student from continuing.
  - A similar approach is to put three cups nested within each other upside down on the computer or monitor. Green on top means "everything is fine"; yellow on top means, "I have work I want you to check"; and red on top means, "I need help."

Q: How do I maximize access to Internet information if I only have one connected computer?

- Download specific websites to the connected computer and distribute to the other computers to view offline.
- Use offline browser software to save websites to the hard drive. For large sites, you may need to save the websites on a Zip® drive or create a CD to view on another computer.
- Project the connected computer to a larger screen, like a TV, so that a group of students or the whole class can view it.
- Print out valuable resources for kids to view.
- Complete assignment as a whole class exercise.
- Put students into groups with the same research needs.

Keywords

ICT in the classroom; hardware; classroom management; equity issues; ICT integration

9. Kahn, T. and Taber Ullah, L. (1997) "Learning by design: Integrating technology into the curriculum through student multimedia design projects." New Horizons for Learning.

http://www.newhorizons.org/strategies/technology/kahn.htm (2 March 2005)

Learning by Design:

Integrating Technology into the Curriculum

Through Student Multimedia Design Projects

by Ted M. Kahn, Ph.D. and Linda K. Taber Ullah, M. Ed.

Computers, telecommunications, and multimedia can be powerful tools for enriching student learning. They are also an essential part of preparing students for a world characterized by knowledge, work, global communications, and continuous learning and change. But in order for technology to be effective in today's education system, it needs to be intelligently integrated into a rich, meaning-centered curriculum. Accomplishing this goal requires designing new kinds of creative learning environments involving the collaboration of all the stakeholders in educational reform -- teachers, students, administrators, parents, researchers, the business community, curriculum specialists, and technology developers.

Type

Online article

Abstract

If technology is to be effective in today's classrooms, it must be integrated into a rich, meaning-centred curriculum. So say the authors of this article from New Horizons for Learning. For this to happen, the efforts of all stakeholders must be harnessed, which includes teachers, students, administrators, parents, researchers, the business community, curriculum specialists, and technology developers.

The article describes the Institute for Research on Learning's (IRL) Middle School Mathematics through Applications Project (MMAP), where students use computer simulation and tools to design dream homes, develop various research stations for scientists living in Antarctica, develop encryption and decoding systems for secret messages, or model population growth of animal species within different ecological systems or habitats.

The authors recommend design projects as a particularly effective way of developing students' higher-order thinking skills, and integrating a variety of technological tools into the curriculum. Furthermore, many subjects and curriculum topics can emerge from a design context. For example, effective mathematics learning opportunities arise for a number of reasons. Firstly, design is reflexive: each new change or addition to a design opens up more opportunities for student participation, feedback, and discussion. Secondly, design requires multiple representations: some design projects involve mathematical, graphic, and verbal representations, as well as extensive social discussions. Finally, design requires tools: students seek out technology and tools to help them with their designs. Thus, technology is not an add-on, but an inherent requirement for accomplishing their design goals.

Excerpts

Student design projects are effective frameworks for integrating technology into the curriculum. Design projects often require effective use of multiple intelligences, develop students' higher-order thinking and problem solving skills, sensitize students to creating a product for use by a real client or user audience, and enable diverse forms of collaborative learning in engaging some students whose talents or knowledge are often not recognized in more traditional classroom environments.

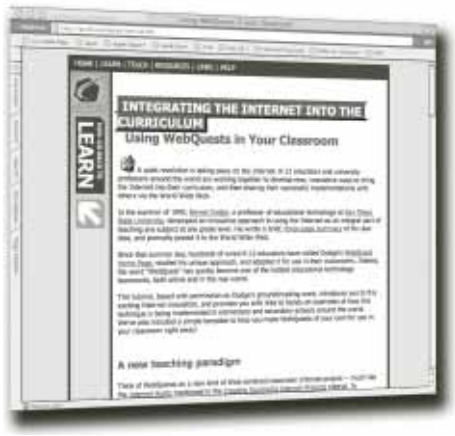
Design projects also encourage making connections across curriculum areas. For example, in the Institute for Research on Learning's (IRL) Middle School Mathematics through Applications Project (MMAP), students use computer simulation and tools to design dream homes, develop various research stations for scientists living in Antarctica, develop encryption and decoding systems for secret messages, or model population growth of animal species within different ecological systems or habitats.

Keywords

ICT in the classroom; multimedia; independent learning; ICT and curriculum; ICT integration

10. Link-to-Learn. (2000) "Integrating the Internet into the curriculum: Using WebQuests in your classroom." Link-to-Learn Professional Development Project.

http://pd.l2l.org/linktuts/inteweb.htm (2 March 2005)



Type

Online article

Abstract

This article introduces classroom teachers to WebQuests, a popular strategy for bringing the Internet into the classroom that is well worth learning. The author describes, with links to real examples, how they can be used for teaching any subject at any level, and be geared to one particular topic or used for multidisciplinary learning, either in short- or long-term projects. This page also contains a template that allows the user to develop their own WebQuest after sampling some successful examples.

Essentially a learning activity in which some or all of the information that students acquire comes from the Internet, WebQuests focus the student on using information, rather than looking for it, and develop their abilities to analyse, synthesize and evaluate that information.

Excerpt

Successful WebQuests always include **six** main components:

- A clear introductory paragraph which sets the stage for the activity and provides some background information.
- A central task that is concrete and interesting.
- A set of information sources needed to complete the task. All of the knowledge sources, both from online and real-world sources, should be given to the students in the form of a WebQuest handout. These pointers to information are vital and ensure that your students are centered on the task at hand.
- A description of the entire process the students should go through in accomplishing the task.
- Guidance on how to organize the information acquired. This can take the form of guiding questions, or directions to complete organizational frameworks such as timelines, concept maps, etc., ultimately resulting in the creation of new Web pages to demonstrate their understanding.
- A conclusion that brings closure to the WebQuest, reminds the students about what they've learned, and encourages them to extend the experience into other domains.

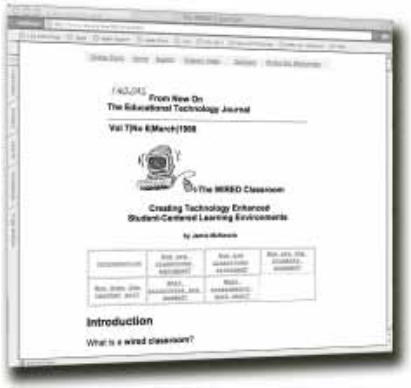
[This page cites Bernie Dodge: *http://edweb.sdsu.edu/courses/edtec596/about_webquests.html* as the source of the above guidelines.]

Keywords

ICT in the classroom; pedagogy; ICT and curriculum; independent learning; ICT integration

11. McKenzie, J. (March 1998) *Creating Technology-Enhanced Student-Centred Learning Environments.* From Now On.

http://www.fno.org/mar98/flotilla.html (2 March 2005)



Type

Online manual

Abstract

This article from *From Now On* addresses the various issues facing the technology co-ordinator and local or district-level educational manager preparing to set up a fully networked classroom. Topics include: How are classrooms equipped? How are classrooms arranged? How are students engaged? How does the teacher act? and What assessments work best? There are also links to valuable resources throughout the text, in particular collaborative projects and WebQuests.

The main recommendations under each of these follow:

How classrooms are equipped: The author recommends a student-computer ratio of at least 1:4, with additional cheap word processing devices. However, the point is made that very little return will be had on any investment in hardware unless it is accompanied with adequate staff development. In addition to hardware, the article also emphasizes the need for adequate storage space for student work to support appropriate levels of gathering and sorting information electronically without any need for printing or saving on diskettes.

How classrooms are arranged: For classrooms to make the most of what hardware is available to them, the author argues it makes no sense to keep computers out of view. Teachers of project-based classes tend to spread them around, creating 'centres of interest'. Indeed, it is often unclear which is the front and which the back of such learning-centred, rather than teaching-oriented, classrooms. Another approach might be to create 'clusters' of computers that divide the classroom into separate zones for specific activities.

How students are engaged: Indicators of a classroom with engaged learners identified here are: students are working on authentic, multi-disciplinary tasks; they participate in interactive learning; they work collaboratively; they learn through exploration.

The author also urges the teacher to consider the following question when setting projects using online sources: Does the task require fresh thinking or mere gathering? Many projects often target style over substance, or effective use of software over valuable content.

How the teacher acts: The teacher is required to be more flexible in his or her approach to classroom practice, at times playing the central role, or "Sage on the Stage," such as when time is a premium. At other times, the teacher must be more of a facilitator, or "Guide on the Side." The latter emphasizes exploration as central to learning, and tends to be guided by a constructivist approach to teaching.

Excerpt

To bring a wired classroom to life, we must equip all students with the technology of questioning, and we must adopt a set of beliefs which clarifies our purpose. One of the best is Engaged Learning, the set of beliefs accompanying "Plugging In."

Characteristics of Engaged Learners*

- **Responsible for their own learning**
  They invest personally in the quest for knowledge and understanding, in part because the questions or issues being investigated are drawn from their own curiosity about the world. Projects are pertinent and questions are essential.

- **Energized by learning**
  They feel excited, intrigued and motivated to solve the puzzles, make new answers

and reach insight. Their work feels both important and worthwhile.

- **Strategic**
  They make thoughtful choices from a toolkit of strategies, considering carefully which approach, which source and which technique may work best to resolve a particular information challenge.

- **Collaborative**
  They work with others in a coordinated, planful manner, splitting up the work according to a plan and sharing good ideas during the search for understanding.

*These concepts are based upon the work of Barbara Means quoted in "Plugging In." [http://www.ncrel.org/sdrs/edtalk/toc.htm]

[...]***The One Computer Classroom***

The strategy of providing a single desktop unit only makes sense if the computer image can be projected for the whole class to see. Few districts can spend the $5,000 to do this properly, but many have seen the wisdom of providing a large monitor (the larger the better) at a cost of $650-$850. This monitor allows the whole class to enjoy virtual field trips, learn search strategies and explore curriculum topics by communicating over the network. It can also be used by teams of students to conduct research and present findings, but this model affords too little access to promote a thriving student-centred program.

Warning! The failure to provide a display device is one of the worst mistakes a school or district can make, whether they are putting one, two, three or seven computers in the room. A display device is a critically important element no matter what the number of computers.

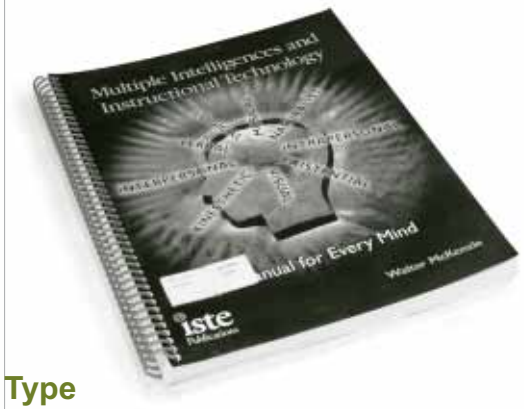
[Teacher role]
When questioning, problem-solving and investigation become the priority classroom activities, the teacher becomes the 'Guide on the Side'.

In a recent hands-on workshop designed to model this type of classroom experience, participants provided the following list of verbs to describe the activities of a teacher who is a 'Guide on the Side' while students are conducting their investigations:

Circulating	Validating	moderating
Redirecting	Facilitating	diagnosing
Disciplining	Moving	trouble-shooting
Questioning	Monitoring	observing
Assessing	Challenging	encouraging
Guiding	Motivating	suggesting
Directing	Watching	modelling
Fascinating	seed planting	clarifying

Keywords
planning; assessment; classroom management; ICT and curriculum; independent learning; ICT integration

12. McKenzie, W. (2002) *Multiple Intelligences and Instructional Technology: A Manual for Every Mind.* Eugene OR: ISTE, 152 pp.



Type
Print publication (For orders, see the ISTE Bookstore at http://www.iste.org/bookstore/)

Abstract
This book targets K-12 teachers, curriculum developers, teacher educators and pre-service teachers. The author takes Howard Gardner's Multiple Intelligence theory and relates it to educational technology, showing how the nine intelligences can be supported with ICT to enliven and even reformat traditional lesson plans. The theoretical content is backed up by copious case studies and sample lessons, and there is also a CD-ROM containing surveys that provide individual MI profiles.

Beginning with a brief outline of Gardner's model, which describes each of nine kinds of

intelligence and how they interact with each other, the author goes on to show how each dimension relates to components of the six National Educational Technology Standards devised by ISTE. For example, the sixth standard, 'Technology problem-solving and decision-making tools' contains the following two themes:

- Students use technology resources for solving problems and making informed decisions
- Students employ technology in the development of strategies for solving problems in the real world

Both these, according to the author, relate to the logical, intrapersonal and existential aspects of Gardner's model.

As far as strategies for integrating technology into teaching are concerned, the nine dimensions inform the use of ICTs in different contexts, and these provide the structure of the book. Chapter 4, for example, looks at the impact the selection of instructional media has on learning, while Chapter 6 presents another model for approaching existing lessons and modifying them according to the MI framework. This is called the POMAT approach - Procedure, Objective, Materials, Assessment, Technology - which is designed to determine the extent to which a lesson is consistent with its objectives in the context of the nine intelligences in the MI model.

Later chapters continue to discuss technology in terms of the MI framework; for example Chapter 9, "Internet-based Instruction," aligns the various forms of Internet technologies with their various intelligences, and goes on to describe, with authentic examples, how each can best be used to achieve different learning aims.

Excerpt

[pp30-31]
Intelligences and digital technologies

Intelligence	Digital Technologies
Verbal/ Linguistic	Keyboard, electronic mail, speech recognition devices, text bridges
Mathematical/ Logical	Graphing calculators, FTP clients, gophers, search engines
Visual/Spatial	Monitor, digital camera/camcorder, scanner
Bodily/ Kinaesthetic	Mouse, joystick, assistive technologies
Musical/ Rhythmical	Speakers, CD ROM disks, CD ROM players
Intrapersonal	Online forms, real-time projects
Interpersonal	Chat, message boards, instant messengers
Naturalist	Floppy drive, file manager, semantic mapping tools
Existential	MUVEs, virtual reality, virtual communities, simulations

How can digital technology stimulate the intelligences? The process is not usually as hands-on as with the Industrial Age technologies. Consider how the teacher Tronie Gunn developed a unit for her students on sorting and searching using spreadsheets. Table 4 [see next page] shows how she is able to address eight of the nine intelligences using a specially structured lesson plan format that allows her to carefully map each element of her lesson to the appropriate intelligences.

In this lesson students learn to sort data in different ways, and then determine from the results of their work which ways of sorting the data are most efficient. Teachers can modify this lesson to use sorting strategies that are most appropriate for their students. The goal is to help children experience the most useful and efficient ways of looking at data via technology.

Notice how Tronie's selection of technologies is consistent with the intelligences she wanted to stimulate through this lesson. Her objective is succinctly stated and the intelligences are clearly indicated in framing the context for the software and hardware she intends to use. The instructional design of the lesson provides the context for the intelligences she selects, and the intelligences dictate the appropriate technologies. Notice, too, that she uses both digital and traditional media in her lesson. Her students can look forward to a challenging, stimulating immersion into the world of spreadsheet filters.

Reflections:

1. How can the ISTE NETS for Students help you to develop well-grounded, technology-based instruction?
2. How does the instructional context help you to determine the intelligences a technology will stimulate?

"Sorting and Searching" lesson

Lesson title: Sorting and Searching **Grade Level:** 10 **Subject(s):**		**Date:** October 17, 2001	**Teacher:** Tronie Gunn Westbury High School Houston, texas **Time:** Two 1-hour periods
Objective(s): Using a spreadsheet, the learners will test standard filters using varied sets of data, comparing each sort for its time and space efficiency	***Intelligence(s):*** *Verbal* *Logical* *Visual* *Interpersonal* *Intrapersonal* *Kinaesthetic*	**Technologies:** Computer lab (Pentium 3 computers), Spreadsheet	**NETS for Students:** Students demonstrate a sound understanding of the nature and operation of technology systems
Materials: Sorting and algorithmic analysis worksheet, overhead transparencies and an erasable marker, playing cards		**Intelligences:** Verbal; Logical; Visual; Interpersonal; Intrapersonal; Kinaesthetic	

Procedure:	**Intelligences:**
Pre-lesson class preparation: Students read textbook chapter which describes a variety of sorting algorithms that can be used in a spreadsheet. Students have previously used Excel. Lesson:	Verbal
1. Provide a brief review/overview (use a computer projector when applicable) of the 10 kinds of sorts students will study and compare, the types and sizes of data that will be used and the investigation tools provided.	Verbal Visual Naturalist
Based on this overview, students will be allowed to select their preferred sort for investigation (first-come first-served)	Intrapersonal
2. Assign each student a different sort to investigate individually using the resources provided (you may assign a sort to more than one student if your class size dictates). Students may use these three resources to conduct their investigation:	Visual Musical Naturalist
Teach Yourself Data Structures and Algorithms CD – provides examples of most of the sorts (in fast or slow motion and for different kinds of data)	Visual Musical
Exposure Supplementary Materials CD – provides visual demonstration for most of the sorts (using dots or bars)	Naturalist Musical

Exposure CD – provides a program in Chapter 43 that allows a detailed investigation of each of the identified sorts, specifying different types of data and providing the elapsed time required to complete the sort.	Logical Kinaesthetic
3. Each student builds an Excel spreadsheet for the algorithm studied. If more than one student investigated a given algorithm, average the results.	Logical Musical Naturalist
Use playing cards to demonstrate a working knowledge of how each sort works.	Kinaesthetic Musical
Reflect on why some sorts do not work for some data.	Intrapersonal Musical
4. Use an overhead projector and transparencies to report results of the investigations and to facilitate comparisons of the different algorithms.	Interpersonal Logical Musical Naturalist
Assessment:	
Completed worksheet	Verbal Logical
Demonstration with playing cards	Kinaesthetic
Class discussion	Interpersonal Intrapersonal

Keywords
multiple intelligences; ICT in the classroom; multimedia; assessment; pedagogy; ICT integration

13. Mead, G. (2001) "Developing and refining effective search strategies for using the Internet in classroom teaching." Technology-integrated Pedagogical Strategies.

http://www.educ.cam.ac.uk/TiPS/mead.pdf (2 March 2005)

Type

Online report

Abstract

This is the report of a study into effective strategies for developing student online research and information retrieval skills. Although drawn from a GCSE (Year 10) Latin class, teachers of all subjects will find these recommendations valuable, as the aim was for students to learn generic skills using Internet-based search engines that would be applicable in any context. The main findings, based on teacher perspective, independent classroom observation and student interviews, were that students access information much more efficiently having defined and refined their strategies before sitting down at the computer, and using electronic and traditional media side by side was the most effective approach.

While students recognized the value of off-line preparation for searching the Internet in the specific case of a class-based study, the report suggests that: a) many students generally felt it was an unnecessary interruption, and they would normally follow a more random search procedure, and b) some considered the Internet to be their own territory, and resented the teacher intruding and regulating how they used it.

Excerpt

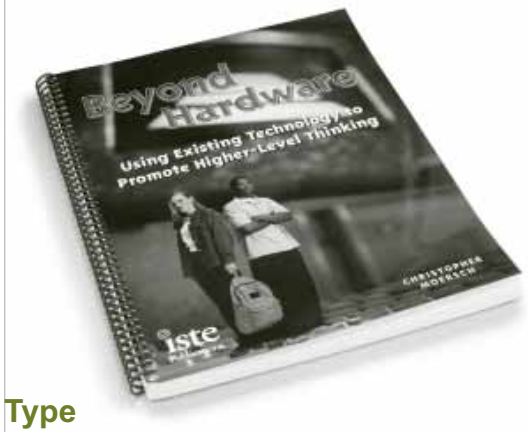
Recommendations

- Generic search strategies and skills should be taught and reinforced throughout the whole school either in ICT or library orientation sessions
- Common search protocol should be followed in all resource-based lessons
- Teachers should pre-select specific sites prior to a resource lesson
- Teachers should set focused, interpretative tasks based on secure knowledge of the potential of pre-selected sites
- Resource-based lessons should integrate electronic and book resources
- Key websites should be catalogued as part of the library management system

Keywords

independent learning; ICT in the classroom; ICT and curriculum

14. Moersch, C. (2002) *Beyond Hardware: Using Existing Technology to Promote Higher-Level Thinking.* Eugene OR: ISTE.



Type

Print publication (For orders, see the ISTE Bookstore at http://www.iste.org/bookstore/)

Abstract

This book from the International Society for Technology in Education (ISTE) is aimed at K-12 teachers, teacher educators, pre-service teachers and education researchers. Chapter 3, "Roadblocks to Effective Technology Use," outlines key reasons many schools have not been able to translate the potential of their technology tools into student achievement. Targeting teachers and administrators, indeed whole school systems, the authors aim to provide ideas and strategies for achieving a higher level of effective technology integration

in the classroom. In brief, the chapter proposes the assignment of the following three elements to achieve greater levels of ICT-enhanced student performance: goals, structures and resources. Poor use of available digital and electronic educational tools can very often be ascribed to the school's goals being poorly set and misaligned to recognized pedagogy; poor resources unable to cover adequate staff development, as well as hardware and software; and lack of response to the need for restructuring a school system in order to support higher levels of technology implementation.

One example of the latter aspect, a need for restructuring, concerns what the authors describe as the 'trickle down effect.' From the Ideal Level, to the Formal Level, the Institutional Level, the Instructional Level, the Operational Level and, finally, the Experiential Level, there are a series of top-down mandates and mixed messages. These begin with government publications and national studies and moving down through district offices and teacher planning before finally reaching the student in the classroom, all of which results in a random use of computers in schools that lack any cohesion or immediacy. For this reason, the authors argue structure must be closely aligned with a school's individual resources and goals.

Other reasons for the poor showing of many schools' technological programmes, all sub-categories of the three main points described above, include: lack of strategic planning; ineffective staff development; insufficient computers; lack of technology leadership; and societal acceptance of non-restructuring.

Excerpt

[pp. 60-61]

Ineffective Staff Development

Change is a gradual process and does not occur over night. The integration of computer technology is a classic example. In an effort to encourage teachers to pursue the opportunities available with new technologies, many school systems have used any one of the following staff development strategies.

Bootstraps approach

The bootstraps approach begins with the principal or several members of the faculty deciding, with no additional support, to implement an innovation. Unfortunately, no resources are tied to this new innovation, but everything that is currently being done must continue. In the world of staff development for technology, this approach is seen all too often. A school system elects to implement a new design for using the Internet for Web projects (e.g., WebQuests, Web folios, virtual tours), yet teachers are 'under the gun' to ensure that students perform optimally in math and reading on the next month's high-stakes testing.

Superstar Strategy

The basic design behind a superstar approach is for a school system to hire an ambitious, bright and upward-bound educator who is well connected in regional or national movements, and who will lead the masses to the new 'Technology Frontier.' The problems with the superstar strategy are as follows:

- Superstars tend to be profession-oriented rather than institution'oriented. They don't wait around the same school system very long because of their ticket on the fast track of the professional career train.
- There is a tendency toward creating an 'us versus them' attitude because the superstar allegedly brings all the right solutions. Teachers do not have any input but are expected to implement these solutions.

For the superstars who remain in the district and bypass other professional opportunities, their influence often transforms from superstardom to what might be termed the 'Moses Effect.' This phenomenon involves the transformed superstar leading the masses along for 40 years, during which time the non-innovators either seek employment elsewhere or retire.

Decree or Mandate

According to Hall [who identified these staff development strategies], the decree or mandate approach is not really a strategy because it occurs often as an event with delivery of the 'Word.' With this 'strategy,' change is announced: 'As of September 1, all teachers will be using online electronic portfolio to conduct portfolio assessments of their students.' The upside of decrees is that everyone in the organization is aware of the administrative priority for the innovation; the downside is that mandates often lead to questionable implementation of the idea.

Keywords

planning; assessment; pedagogy; hardware; software; ICT integration

15. Payton, T. (April, 1997) "Tips on integrating technology into the classroom curriculum." techLEARNING.

http://www.techlearning.com/db_area/archives/WCE/archives/payton1.htm (2 March 2005)

Type

Online article

Abstract

This article provides some important management tips for using computers in the classroom, aimed at teachers faced with new technology in their school. The management tips comprise:

- Use centre approach that rotates the students through teacher-led exercises, and then into hands-on activities, both collaborative as well as computer-focused
- Create heterogeneous groups within the class
- Appoint a student-helper within each group, so that support can come from within when needed
- Maintain good class discipline

There are also tips on how to integrate the Internet into the curriculum, with particular attention to developing online projects. The author recommends that you join an educational mailing list, listserv, or discussion group to keep up with current online projects, and avoid publishing a "show-and-tell" art gallery. Most people who visit your website are usually looking for examples of how they can integrate the Internet into their curriculum. Brainstorm with colleagues ways that you can collaborate with other classrooms around the world to get information, and build an interactive webpage. Also, you can find a list of suggested sites where you can register your project at the "OnLine Projects" webpage.

Excerpt

Whether you have computers within your classroom or in a lab setting, here are some tips to help you develop technology integration.

1. If you need to cut corners, don't cut it by leaving out a substantial amount allotted for training. Before you purchase software, find out how much training (if any) is included with the purchase price. Training has helped us know our software. Without an understanding of what software can do in the curriculum, you'll never utilize its full potential. Two schools purchased the same software. Teachers in one school were satisfied with the product and teachers in the other school were frustrated with it and rarely used it. The difference was in their training. The frustrated teachers had only one training day during the summer and it was not mandatory.

2. Have your training sessions set up by grade levels or teaching disciplines. Offer released time so that teachers can collaborate and create technology activities that are integrated for thematic or chapter lessons. Every year for the last 3 years at our school, each grade level or teaching discipline has been given 3-5 days released time. By spreading our training sessions throughout the year, teachers can work with the software and then ask questions about the software at the next training session. Each training session has been conducted by a representative from the software company.

Keywords

ICT in the classroom; pedagogy; staff development; classroom management; ICT integration

16. Preston, S. and Wadsworth, P. (2001) "A study of how the Internet can be effectively integrated into lessons." Technology-integrated Pedagogical Strategies.

http://www.educ.cam.ac.uk/TiPS/wadspres.pdf (2 March 2005)

Type

Online report

Abstract

This study aims to address the dearth of practical guidance for practising teachers in planning and structuring lessons that use the Internet as a teaching resource. The study centred around Year-9 science classes, and focused on the elements of a good lesson, and in particular planning, especially lesson structure, classroom management and responding to technical difficulties. The data collected from staff and student questionnaires, as well as interviews, found that 'successful' integration of the Internet into classroom practice involves well-planned and clearly structured lessons, efficient searching and well-defined objectives.

Briefly, the following recommendations were made:
Lesson structure: Lessons should include a variety of activities; previewing the websites to be visited is essential on the part of the teacher; using a non-computer-related 'hook' for setting up the activity and establishing ground rules often works well; structured work sheets allow students to work more independently of the teacher.

Need for guidance: While 63% of the teachers in the study used the Internet for student research in the classroom, only 45% use it for lesson preparation, a discrepancy which points to a need for greater staff training. This report contains a good practice guide to that end.

Excerpt

Specific recommendations include:

- Ensure lesson objectives are clear.
- Keep an annotated record of possible sites.
- A good web site will have all the required information within 3 clicks of the mouse (limited hyperlinks).
- Build in differentiation – different web pages, structure of questions, nature of tasks etc.
- Consideration of lesson structure. The teacher must be in control of student surfing. We suggest that you prescribe the activity and specific URL or use a structured worksheet.
- Do pay attention to the grouping of students and the number of computers available.
- The lesson must have a product e.g. poster, free writing, presentation etc.
- Evidence suggests that the best lessons have a clearly prescribed activity and specific URLs. This may be achieved by using a structured worksheet or by discussing the task with the class.
- If a worksheet is not being used, limit the number of websites to only one or two. A worksheet will allow more flexibility if many sites need to be accessed.
- Ensure that clear instructions are given to students about the site(s) they to visit and the information that they are to gather.

Keywords

classroom management; science; planning; pedagogy; staff development; ICT integration

17. Trucano, M. and Hawkins, R. (January-March 2002) "Getting a school on-line in a developing country: Common mistakes, technology options and costs." *Techknowlogia Vol. 4, Issue 1.*

http://www.techknowlogia.org/TKL_active_pages2/CurrentArticles/main.asp?IssueNumber=15&FileType=HTML&ArticleID=368 [or http://www.unescobkk.org/education/ict/v2/info.asp?id=11017] (2 March 2005)

Type
Online article

Abstract
This is a list of important questions to consider when preparing to establish a networked school. Principals, policy makers and ICT co-ordinators will find a huge range of frequently asked questions that are vital to consider ahead of any moves to get your school connected. The range of things to consider is potentially mind-boggling, and this resource makes it clear just how much forethought is needed. For example, in many countries, getting a telephone line installed is no easy (or cheap) task: you must consider procedure, waiting period, installation fees and monthly charges, whether phone lines can support data, policy regulations for obtaining a VSAT license and duty on imported computers. These and many other issues are clearly outlined and divided into the following themes:

- General overview of telecommunications environment
- Competition in telecommunications sector
- Costs and policy environment
- ISP information
- Connectivity costs
- Equipment
- Software
- Individual school information
- Human resources

Excerpt
Software

Network software that they sell and support: Do they offer technical training on network management?

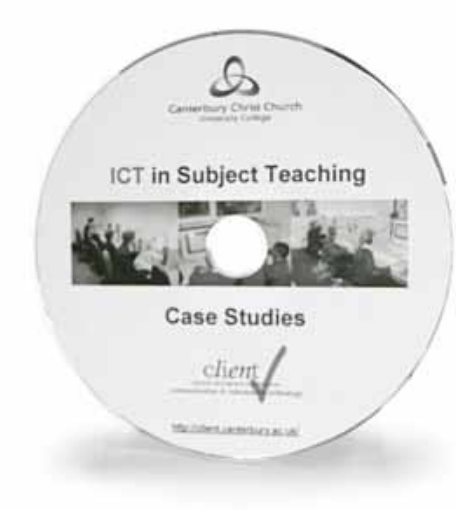
Workstation software that they sell and support: Is the software available in the local language? Do they offer training on computer literacy?

Individual School Information

- Names of schools
- General information about school (including number of students, gender, type of school, subjects taught, number of grades/levels, number of teachers, number of administrators, school fees)
- Location (city, region, urban/rural)
- Access to electricity (already electrified? reliability of electricity? distance to electric grid? generators?)
- Number of phone lines (type of phone line, who has phone lines)
- Can the phone lines support data?
- Number and type of existing computers (include information on network configuration, network cards, printers, UPS systems, modems, other peripherals, and software)
- How are existing computers being used? By whom? If not, how will they be used, and by whom?
- Why does the school want to participate in the programme?
- Total number buildings on campus and number of floors
- Total number of classrooms in each building
- Is there a school library? (How big? Who administers it?)
- Total number of rooms to be connected
- Physical size of room to be connected
- Classroom quality (secure/safe, dry, dust-free)
- Electricity outlets
- Does the community on evenings/weekends use the school?
- Other relevant information

Keywords
software; hardware; classroom management; planning; policy/strategy; ICT integration

1. Canterbury Christ Church University College, UK. (2003) ICT in Subject Teaching.



Type

CD-ROM (For orders, and related online content see: http://client.canterbury.ac.uk)

Abstract

This CD-ROM contains a number of case studies describing the integration of ICT into various curriculum subjects, in primary, secondary and SEN schools. These studies describe how many different kinds of technological tools can be used to support teaching across the board, for example, in geography, science, language arts, music, mathematics and business studies. Some schools describe how ICTs in general, have become embedded in class activities, while others provide tips and guidelines for using specific tools, such as SMART boards, digital photography, PowerPoint, e-mail and others for achieving particular learning outcomes. Each case study contains downloadable files containing the resource material used.
Some sample case studies include: Exploiting a French school website; using digital cameras and PowerPoint to show how plants need light to grow; digital photography to analyze performance in PE; using a SMART Board to support the learning and teaching of children with SEN; and using PowerPoint to support hearing-impaired children.

Excerpt

***Exploiting a French school website*:** Four members of the Modern Languages Department took part in the ICT training which covered the use of word processing, Microsoft PowerPoint, data-processing, e-mail, CD ROMs and websites to enhance learning. Having completed assignments on each of these topics, each trainee then carried out a project which involved planning and delivering a lesson using at least one of the applications. For her project lesson, Fiona Twomey planned to work with a Year 10 group of very mixed ability pupils and to involve them in working with a specific website.
The class used networked computers in an ICT suite with Internet access and web browser. The website was also copied onto the school's intranet as a back-up precaution.

The objectives were that pupils should:

- learn how to browse a site in order to find relevant pages
- develop their skills of skimming and scanning as well as close reading of text to obtain precise details
- learn an extended and authentic vocabulary relevant to the school topic
- read for pleasure by choosing an aspect of the site which particularly interested them
- learn to report their findings to the rest of the group
- appreciate the cultural differences between their own and the French school.

The objectives of the lesson were explained to the group so that they knew they would be expected to access and browse the site to find relevant details as well as information of personal interest. Pupils were then given a worksheet containing questions, which they had discussed in the previous lesson to ensure understanding. Pupils logged on to the site following instructions displayed on the board and worked through the sheet, which was divided into four sections.

Section 1 contained easier factual questions, such as 'Où se trouve le collège?' (Where is the school located?) or 'Comment peut-on y aller?' (How do you get there?). Section 2 asked pupils to find the French for eight expressions, such as 'parents' evening' or 'aerial photo.' Section 3 was a more open-ended task, giving pupils time to explore the site and find something of personal interest to them. Section 4 contained eight more demanding questions, some of which asked pupils to express a personal opinion or to speculate as to why things might be so. For example, 'Pourquoi est-ce que les élèves voyagent en Angleterre?' (Why do the pupils travel to England?)

Pupils worked at their own pace according to ability. Two help cards, one linguistic and one technical, were available, as were dictionaries for those who needed extra support. During the last fifteen minutes of the lesson, Fiona checked Sections 1, 2 and 4 with the group and they corrected their findings for Section 2 as necessary. For homework, pupils were asked to learn the phrases they had found on the site for Section 2, to prepare a presentation and to complete a written task in which they had to fill in twelve key words that had been removed from a print-out of a page from the site. In following lessons, pupils were asked to speak briefly about a part of the site which had interested them and later to write two paragraphs, as if for their school prospectus, in French. Both of these tasks formed part of the group's preparation for GCSE coursework. Their learning was assessed by means of a three-part task consisting of:

1. A vocabulary test, where pupils placed words found in the site in an appropriate context
2. A competition giving pupils five minutes to write as many differences as possible between British and French schools
3. A fixed time of fifteen minutes to discover a new site. Pupils had to access one of two sites (one primary and one secondary school) without help, explain its structure and make brief notes on a section they found interesting.

***Using ICT to develop an awareness of phonics*:**

The Foundation teacher wanted to use ICT to support work the class were doing in Literacy. Whilst focusing on word work/phonics progression for Foundation in the Literacy hour, the children were asked to select specific sounds on the programme: c, m, s, t, g, h (Using the 'Rat a tat tat' CD Rom). They needed to use the information gathered during their experience and present it to the class in subsequent lessons/plenaries in support of identifying the sounds.

The children have access to a small bank of three or four PC systems most of which are in areas adjacent to the classroom. They worked at the computer in pairs or individually with support from a partner and classroom assistant. Discussion took place at the computer and several questions were posed whilst using the CD Rom, such as:

- Which letter are you selecting?
- Can you name the letter?
- Can you name the objects?
- Can you think of another object which could be displayed on the screen?

The learning objectives were linked to the National Literacy Strategy and focused on providing the children access to the spoken and written words and sounds:

- When you hear this particular sound, it is written like this.
- When you hear this particular word, it is written like this.
- When you see this particular sound/word, it says this.

The following key questions were identified by the teacher working with the children:

- What is this letter?
- What is this word?
- Why have you selected this particular letter/picture?
- Which letter are you selecting?
- Can you name the letter?
- Can you name the objects?
- Can you think of another object which could be displayed on the screen?

The activity on the computer provided a visually stimulating lesson for the children, one in which they were having fun whilst learning letter sounds and names. The children were able to repeat the activity as many times as they wished, to reinforce their learning and provide appropriate feedback. Using the CD Rom enabled the teacher to differentiate the activities and provided the opportunity for children to work independently once they became familiar with the activities.

Keywords

ICT in subject teaching; special educational needs; case studies; hardware; educational software; independent learning

2. Department for Education and Skills, UK. (undated) Embedding ICT @ Secondary.

Type

CD-ROM (For orders, see: http://www.dfespublications.gov.uk/cgi-bin/dfes)

Abstract

Case studies describing good use of ICTs in subject teaching are included here, covering 12 subjects at KS3: English; Maths; Science; Modern Foreign Languages; Geography; Art and Design; History; Music; Design and Technology; Physical Education; Citizenship; Religious Education. The CD also contains lesson plans and support resources, which contain useful links and guidance, as well as standards and indicators from the National Curriculum in the United Kingdom.

The video files show ICT in use in various class-based activities, as well as follow teachers through their lesson preparation. In English, for example, the viewer sees how a teacher can use notepad software to create text boxes that allow paragraphs to be moved independently on the interactive whiteboard, search for text of Shakespeare plays using an online search engine, and understand how ICT-based materials can be more motivating for the students, but also for the teachers, who work collaboratively and share resources they have created.

Excerpt

English

In this lesson, I wanted to use the PCs to differentiate learning, so we didn't need to be in a room where everyone needed to be on a computer. I used the PCs to support the learning and the esteem of the lower ability students and challenged the more able students to do a task that was much more difficult. It allows for students who are less able to be seen to be participating in the lesson in exactly the same way as everyone else, and it is meeting their needs without highlighting them ...They looked at the beginning of the Tempest and were writing their own dialogue to match the stage directions. The lowest ability had a scaffolded version where they deleted the dialogue, so they had all the stage directions but they had to enter the dialogue. More able students were also deciding which order the stage directions ought to be occurring. The advantage to using ICT for written work is that students can continually improve their written

work. If they save a draft through ICT they can go back and make amendments and add things, and it becomes a document which more truly reflects their work over a longer period of time.

Maths
An interactive whiteboard enables the teacher to become an interactive member of the lesson. It enables me to engage all the students in the lesson, and I know each student is focused on what I'm doing on the board. You can face the class and...the questions they ask, and how readily they're available to put their hand up, help me to assess their understanding, and the expressions on their faces. One thing I do if I see someone's not engaged is ask them a question, and maybe get them demonstrating to the rest of the class, so they feel involved in the lesson. When they're explaining what they're doing to the rest of the class it is an ideal time for me to assess them and it helps the students' confidence – they are explaining what they are doing to other members of the class.

I like students using the laptops in my room because the mathematical resources are around them and I haven't got the problem of going to book an IT suite. Students working collaboratively on a laptop seem much more focused than working on pen and paper. I don't like asking questions for the sake of it. If they're working well on task and they're asking each other questions and answering each other then I can peer over their shoulder, to see what they're doing, the angle the screen's at, I don't have to walk over to see if they're focused on task and ask unnecessary questions, I can spend my time with the students that need it.

Art and Design
The use of digital image manipulation software introduces students to the concept of computer graphics software as an art tool. Distorting images may help to break down students' preconceptions about non-conventional art forms. Digital art should inspire students to produce work at a higher level.

Analyzing and assessing students' work:
The room layout helps the teacher assess how the students are working. Intervention and support are facilitated - students can talk through their choices as they do them. Students present some of the effects they have discovered part way through the independent work. They re-focus on the task and see what others are doing. Less able students can produce good images so they are more confident to put their work forward for critique and artistic discussion.

Music
I have to make sure that they are comfortable with the musical concepts before they apply it to the computer, but I have found that using the computer has enhanced the students' understanding of the notation.

Keywords
ICT in subject teaching; case studies; multimedia; pedagogy; independent learning

3. British Educational Communications and Technology Agency. *ICT Advice.*
http://www.ictadvice.org.uk/
(2 March 2005)

Type
Website

Abstract
This site from Becta offers subject teachers general guidance and strategies, as well as specific examples, for using ICTs in subject teaching at both the primary and secondary level. By clicking on one of the subject areas in the drop-down menu on the right of the screen, you can choose from a range of topics describing how various technologies can be used to enhance your teaching.

For example, clicking on "Art and Design" under 'Secondary' brings up a number of

strategies under the 'inspire me' heading, including:

- Practicalities of using ICTs in art and design: Children can get carried away with the technical aspects of programs, so it is better to start with something simple; manufacturer manuals can be daunting - write your own simplified version instead; or even get more adept students to write guides for the other pupils; good practice demands that the best tool be used for the job - even if that means traditional media; avoid tools that mimic traditional materials - instead, choose those which open up whole new ways of working; get students to work from life and the screen simultaneously;
- Using the Internet in art and design: human contact and collaboration are two advantages of the Internet, and vital for art projects - students can explore websites of famous artists, both living and dead, learning more about their techniques and exchanging images by e-mail around the world;
- Creative use of digital effects in art and design: software packages can encourage experimentation, like distortion and fragmentation, such as when studying Francis Bacon or David Hockney; digital media can allow students to isolate or enlarge elements of an image for closer study.

There are external links, too, such as National curriculum in action: ICT, art and design, and a page describing a student's entitlement to ICT in secondary art and design.

Excerpt

[http://www.ictadvice.org.uk/index.php?section=tl&catcode=as_cu_pr_sub_13&rid=3597]

Science (Primary): Supporting Information for Primary Science

When planning the science lesson, you will probably want to start with NC statements or learning objectives from the DfES/QCA exemplar scheme of work. ICT should be chosen as a resource only if it will support the teaching and learning of these objectives. When used appropriately, ICT can enhance teaching and learning by, for example, providing animations and video of the concepts, which can help pupils to understand scientific phenomena. ICT can also give pupils and teachers an opportunity to use a model to change variables and investigate the effects in situations that are impossible to carry out in the classroom.

If you have access to a large-screen display or LCD projector, ICT can enhance the learning of a whole class, as children can now have access to a shared experience. You can demonstrate the use of a datalogger to collect and analyse data, displaying the information graphically, or model concepts and ideas using software simulations and video. Children can benefit from the interactive nature of the technologies to explain and present their work. The role of the teacher is paramount in raising standards in science. When ICT is used as a demonstration tool, it allows the teacher to demonstrate scientific concepts and models, to explain and ask questions, to stimulate discussion, invite predictions and interpretations of what is displayed and to encourage individual children to give a response or explanation. ICT can also be used to enhance individual learning, with structured tasks and activities focused on the scientific ideas. ICT can be used just as effectively in the plenary session where children can demonstrate and explain what they have learned, and showcase their work.

Just as you select appropriate science activities for your pupils, you need to select computer activities that require appropriate levels of ICT skills. If the children are struggling with a new aspect of the technology, this may have a negative effect on their learning in terms of science. The science lesson should not normally be used for the teaching of new ICT skills – with the possible exception of datalogging.

Keywords

ICT in subject teaching; policy/strategy; multimedia; pedagogy; standards; independent learning

4. Martin, M. and Shelley, O. (2001). "Poetry and ICT in English: Text Re-versioning." Technology-integrated Pedagogical Strategies.

http://www.educ.cam.ac.uk/TiPS/martshel.pdf (2 March 2005)

Research Report October 2001

Researchers : Mary Martin and Oliver Shelley

Date of Research : November 2000 to July 2001

Contact Address : Comberton Village College
West Street
Comberton
Cambridge CB3 7DU

Research Topic : Poetry Analysis and ICT in English (Text Reversioning)

Pupil Age Range : Year Nine

What were our original aims?

The initial focus for our research was to be on text reversioning (the physical reorganisation of an existing text so as to explore form, content genre, etc). We had identified two classes to involve in our research - two Fast Track Year Nine groups, both single sex groups: Mary Martin (MM)taking the boys' group and Oliver Shelley(OS) the girls'. We felt that a focus on text reversioning could be included as a logical, useful adjunct to the work we would be doing to prepare students for their KS3 tests. This was especially important since the main phase of our research, when we would be producing and trialing the majority of lessons and resources, coincided with the stage in the Year Nine course given to exam preparation. Our key aims, then, were as follows:

Aim 1 : To improve pupils' capacity to examine texts, identifying the techniques by which writers persuade and affect.

Aim 2 : Use provisionality function of ICT to explore ideas at structure, register and texts

Aim 3 : To develop awareness of how text works at word, sentence and text level

In what ways did we refine our aims?

Aim 1 :

We maintained this aim but we decided to refine it by focusing on poetry only including Shakespeare's Macbeth (this as a consequence of the students' preparation for the KS3 exams). We decided that it could be productive to create a poetry course designed to teach

Type

Online article

Abstract

This report describes the research of two teachers in the UK into how ICT could help Year-9 poetry classes with text re-versioning, (reorganizing text to explore form, content, genre) and with identifying the ways authors develop arguments, structure and register. Lesson observations found that there was a need to develop ways to monitor both the extent to which students were staying on task and actual learning gains. It was felt that the nature of the ICT lab does not lend itself to the deeper discussion that a traditional classroom allows, in particular in terms of poetry analysis. This was in part due to the subtle interaction that poetry discussion requires, which is not possible in the busy atmosphere of ICT suite. Where dialogue between students in groups tended to be limited to functional ICT-related conversation. Tasks were, thus, reorganized to set time for specific tasks, and to encourage more meaningful and text-focused discussions.

The report also includes questions that some students were asked to respond to in the form of a diary, and sample responses. Questions comprised:

1. What were your expectations for this particular lesson?
2. What was the task in outline?
3. What actually happened in the lesson? If you can narrate and identify particular stages this would be helpful.
4. Try to log any specific moments of learning.
5. How could the lesson structure have been improved?
6. Comment on the pros and cons of collaborative work in this particular exercise.

Excerpt

The learning points we gained from undertaking the research and what evidence we had to monitor this:

Lesson Observation

1. Both boys' and girls' groups *seemed* to be engaged and enjoying lessons. However, we feel that it is important to state that there is undoubtedly a fashionable "buzz" factor about ICT lessons which lends them an air of pupil engagement whether or not learning is being moved on through the work or not. Our project benefited from the pupils' natural enthusiasm for what is still currently perceived as a desirable teaching strategy.
2. Productive oral collaboration. Our observations, as well as the research diaries and interviews, provided us with evidence of some effective group work in response to tasks.
3. Imbalance of pupil hands-on practice at the keyboard.
4. Pupils needing guidance in content and skills. We discovered at different times that the skill base was uneven; some pupils did not have the technical skills or they were slow and this, of course, had an impact on how much they got out of the lesson.
5. Great variety in rates of working and products. For example, technical virtuosity did not necessarily mean that the work produced was insightful.

Interviews

- We discovered that there was a skill deficit among perhaps half of the boys which was masked by the pair work. This came to

light when alternative "sugar-paper" analysis was offered to decongest computer use; to our surprise we found that almost half of the boys declared a preference for this non-ICT collaborative analysis. We had to acknowledge our own prejudice in assuming a skill base in the boys that turned out to be less comprehensive. It became apparent to us too that many boys had deliberately hidden this lack of facility to avoid embarrassment.

- Both boys and girls said that the "sugar-paper" analysis aided their understanding of the exploration of the poems in a way that the ICT work hadn't. A particularly clear example of this occurred when we did work on assonance and alliteration. (See also point below).
- It was in our interviews with the girls that we identified one of the key findings of our research; the clear difference between the way boys and girls seem to respond to ICT.
- We found that students expected there to be a greater variety of ICT tasks; *they* thought that the emphasis was to be on the acquisition of ICT skills, whereas *we* were very clear that we wanted the ICT to enhance English learning strategies. (link to variety stuff)
- Recognition by teacher and pupil that the poem needed to be read aloud and heard in the room.
- In general, these diaries were not kept in a consistent fashion and, in general, they were kept by only a thirty percent sample who varied each time, but had a recurrent core of four or five pupils. Time for completion close to the lesson was difficult to find, and we did not want to sacrifice lesson time for completion.
- Ideally, pupils needed more training time for more thoughtful completion of the diaries and, ideally, they needed to be completed straight after the lesson.
- As we have already mentioned there were complaints in the earlier lessons about repetition of lesson tasks and strategies.
- An emphasis in their perception of outcomes on technical tasks was accomplished.
- Recognition as the lessons progressed that the text under scrutiny needed to be short so that the whole could be viewed on the screen at one time.
- Complaint about the lack of discussion in the lesson.
- Complaint about the lack of individual teacher help.
- Pleasure at seeing the tightly-wrought nature of a poem.
- Failure in the earlier lessons to appreciate the overall meaning of the text.
- Students enjoyed the provisionality that ICT use brought to the tasks.
- Some students felt that ICT use improved their understanding of the poems.

Keywords

language arts; pedagogy; classroom management; case studies; ICT integration

5. Qualifications and Curriculum Authority, UK. *National Curriculum in Action.*

http://www.ncaction.org.uk/index.htm (2 March 2005)

Type

Website

Abstract

This site from the UK provides resources, ideas and examples of how to integrate ICT into subject teaching, covering all major curriculum areas: art and design, citizenship, design and technology, English, geography, history, ICT, math, modern foreign languages, music, physical education, religious education, science.

Choose a subject from the scroll-down menu on the top left, and then click on one of the links under 'ICT in [Maths]' in the right-hand

menu. There are statutory requirements for ICTs, opportunities for using ICTs in your subject with links to specific examples, as well as descriptions of useful hardware, generic software and Web resources.

For example, under English [*http://www.ncaction.org.uk/subjects/english/ict-lrn.htm*], the suggestion that ICTs can help students be creative and take risks links to the lesson plan 'creating poems from templates,' which includes objectives, material (a poem) and commentary describing the use of the ICTs. 'ICT statutory requirements' in the right-hand menu outlines the requirements for ICT in English at all key stages, while 'ICT opportunities' links those requirements to specific activities. Suggestions for hardware include interactive white boards and networked PCs with Internet access; generic software recommends creative software packages, such as desk top publishing; while online resources include cultural centres and museums dedicated to particular authors or their works.

Excerpt

[*http://www.ncaction.org.uk/subjects/geog/ict-lrn.htm*]
Geography

ICT LEARNING
ICTs help pupils learn in geography by providing and extending access to large quantities of information. It can help them investigate, organise, edit and present information in many different ways.

Using ICTs can help pupils to:
- access, select and interpret information (see examples)
- recognise patterns, relationships and behaviours (see examples)
- model, predict and hypothesise (see examples)
- test reliability and accuracy (see examples)
- review and modify their work to improve the quality (see examples)
- communicate with others and present information (see examples)
- evaluate their work (see examples)
- improve efficiency (see examples)
- be creative and take risks (see examples)
- gain confidence and independence (see examples)

In geography, ICT can help pupils:
- enhance their skills of geographical enquiry
- extend their graphical and mapping skills, and their skills in statistical and spatial analysis
- provide a range of information to enhance geographical knowledge and provide raw material for investigation
- provide access to images of people, places and environments and how environments change
- support the understanding of geographical patterns and processes and environmental and spatial relationships
- enable them to simulate or model abstract or complex geographical systems or processes
- enable them to communicate and exchange information with other pupils and adults in their own school and in similar/contrasting regions
- contribute to pupils' awareness of the impact of ICT on the full range of human activities and the changing patterns of economic activities

[Clicking on the first point above: access, select and interpret information (see examples) brought up a number of examples of lessons for interpreting information, including:]

GIS maps: Investigating the quality of life in Brazil
Activity Description
In this 20-minute task, the pupils explored regional variations in the quality of life in Brazil using geographic information system (GIS) software. (GIS combines mapping functions with data analysis and representation to provide ways of visualising a location.)

As an introduction, the pupils used GIS to manually construct a dot map showing the class 'population distribution' and a choropleth map (using shading and symbols) to show the class 'population density.' They worked from an activity sheet in a geography textbook and they used a map of states in Brazil from a website (which could be read by GIS software) as a base map. They downloaded data on the quality of life from the Brazilian 1991 Census.

Next, the pupils worked in small groups to explore GIS maps. They looked at a dot map of population distribution and compared it with the one they had constructed. They also compared a choropleth map showing the

number of people living in each state with one showing population density. They investigated how altering the colour ramp changed the map's appearance and discussed the most effective colour ranges. They also explored how the maps could be rapidly redrawn, for example using dots of different values.

The teacher explained how the indicators from the census showing quality of life were selected. After the class had discussed which would be the most significant variable, the pupils made a map to show regional variations in the quality of life and noted which areas had the highest and the lowest qualify of life. They then mapped two indicators and predicted the spatial distribution of a third. The pupils noted that some indicators were positive, while others were negative.

The pupils used a default option in the GIS to draw choropleth maps with five classes. The more able groups explored the effect of altering the number of classes. After mapping five variables, the pupils identified the regions with a lower quality of life and those with a higher one. They compared the distribution of indicators showing quality of life with data on rural and urban populations, and discussed the human consequences of this, for example rural-urban migration. In addition, they used the software to produce layouts to record their maps, for inclusion in their notebooks and for a wall display.

ICT resources used:

- a suite of networked computers
- geographic information system (GIS) software
- the internet
- a CD-ROM.

Activity Objectives

- To identify regional variations in quality of life in Brazil.
- To investigate ways of identifying differences in development within a country.
- To make thematic maps using geographic information system (GIS) software.
- To understand that the form and appearance of digital thematic maps can be controlled by the user.

Commentary

Using ICTs

Conventional atlases can show thematic maps in a convenient and portable form. Using GIS tools, however, allowed the pupils to explore patterns in the data as well as the way in which the data was represented cartographically. In addition, the use of ICTs enabled the pupils to review many more maps than they could have made manually in the time available.

The pupils selected relevant data sources and represented the data using an appropriate style of thematic map. They assembled evidence for the varying quality of life in Brazil and noted that some regions shared negative features whereas others shared positive features. Significantly, using the GIS software allowed the pupils to discover that the form of a choropleth map is not fixed but is subject to decisions taken by the map-maker, such as how data should be classified and whether it is normalised by area or by total population.

This led some pupils to realise that maps can be misleading. They considered the different visual impression created by a map showing numbers of illiterate people with a map showing the proportion of the total population who were illiterate. The contrast in patterns encouraged them to ask intelligent questions about the maps in their atlases and to be clearer about what exactly was being shown. By acting as map-makers themselves, pupils achieved a deeper understanding of how maps work.

In a subsequent lesson, the pupils used the query builder tool, which allowed them to identify states that are, for example, high on illiteracy and low on participation in higher education. This task was presented as a problem-solving exercise whereby the pupils advised the Brazilian Minister for Education on where additional resources should be targeted.

ICT programme of study references: 2a, 2c

Keywords

ICT in subject teaching; pedagogy; standards; ICT and curriculum; hardware; educational software

6. International Society for Technology in Education. (2004) *National Educational Technology Standards for Students - Connecting Curriculum and Technology. ISTE.*

http://cnets.iste.org/students/s_book.html (2 March 2005)

Type

Online book

Abstract

This online publication from the International Society for Technology in Education (ISTE), developed by curriculum standards experts in a range of curriculum areas, provides examples demonstrating how technology can facilitate implementation of standards-based curriculum while supporting technology literacy among students.

The publication begins with a broad overview of issues in integrating technology into the curriculum, and contributes with an outline of technology standards, profiles of technology-literate students, and indicators.

The book then focuses on five main curriculum areas – English language arts, foreign language, mathematics, science, and social studies – and offers learning activities that can be accessed online or downloaded as .pdf files. Each lesson idea includes the relevant standards, software and hardware needed, links to other resources and tips for effectively using ICT to enhance the learning outcome.

The general focus is on the curriculum - discipline-specific, content-area curriculum - with technology seen as a tool to foster higher-level outcomes. With this in mind, there are several questions that influence how technology is used in the classroom:

- What if there is limited access to the technology?
- How can a lesson meet both curriculum standards and NETS (National Educational Technology Standards) for students?
- How can technology be used in ways that optimize instruction?

As far as access is concerned, the guidelines in this book take into account all technology levels, from one-computer classrooms to environments where there is a one-to-one student-computer ratio.

Where there is only one computer for the entire class, the author suggests a number of ways that it can be used as an effective tool for instruction:

Co-operative Group Station: Assign different topics to individual groups within a larger study. Have at least two topics dependent on the use of the computer. In this way, two groups will be allotted significant time on the computer during the project. Additional time outside the group meeting time can be set aside for other groups to access resources or prepare presentations. It is important to ensure a rotation such that all students have an opportunity to participate in the technology-enriched activity.

Demonstration Station: Instruct an entire class at one time, using a large-screen monitor, LCD panel, or classroom television connected to a computer. The teacher can operate the computer and/or rotate the job of "computer engineer" between students, providing them with some hands-on experience and positive reinforcement.

Independent Research Station: Place the computer in a location that enables groups to access electronic resources, as needed. Some teachers find that a sign-up sheet promotes equitable access.

Learning Centre: Position one computer as part of a well-defined activity. This station should be one within a rotation of a group of learning centres.

There are also a variety of ways the teacher can organize computer labs if they are fortunate enough to have access to one:

Co-operative Groups: Small groups of students work together in the lab to find specific resources or information. They can be assigned different aspects of a problem and compare online information, or do different parts of a project (e.g., preparation, searching, and desktop publishing).

Short-Term Technical Skill-Building: The lab is used as a place to teach students how to use a specific piece of software to enhance a

current project. On-demand learning is most efficient when all students are able to practise the skill quickly and accurately, under the tutelage of a teacher and computer specialist.

Small Group Instruction: In this setting, small groups of students work with the teacher on a specific topic or skill while the rest of the class is engaged in another activity. Small group instruction may be electronically mediated and utilize electronic tools to check understanding.

Each of the five curriculum areas within Curriculum Integration Lessons is preceded by an introduction that describes the use of technology in that particular curriculum, as well as an overview of the learning activities within the section. There are powerful uses for technology in the teaching and learning of other curriculum areas, such as music and art, but the main focus of this book is on the five subject areas: English language arts, foreign language, mathematics, science and social studies.

Excerpt

English language arts
[http://cnets.iste.org/students/pdf/6-8 BirthstoneProject.pdf]

Birthstone Project with a Multimedia Twist

Purpose: English language arts, science, and technology come together in a meaningful way through research and writing about personal birthstones. Students focus on planning and pacing to build their study skills.

Description: This lesson sequence is designed to be an interdisciplinary project for an English language arts teacher, an earth science teacher, and if possible, a technology teacher. The lessons focus on English and language arts as the vehicle for expression and analysis of valid material. Students learn about their birthstones, as well as the mineral industry, through online research, writing, and development of an electronic presentation.

Science class procedure

1. Have books, charts, and periodicals available in the science classroom. Research begins as students discover and identify their birthstones. Internet research is combined with traditional materials in studying the stones within the context of the earth sciences.

2. If possible, create a phoney site with misinformation. Point students in its direction, with the teaching objective that they learn to question and challenge the information they gather and its source.

3. Students fill in their research outline for an essay to be written later. As part of the research phase, emphasize taking notes for a bibliography.

English language arts procedure

1. Students write a narrative essay titled 'Circumstances of My Birth.' This autobiographical piece requires students to do some basic research, and its purpose is to generate interest in and enhance the success of the research writing task. This piece will act as a prologue, in each student's own voice, to the formal research paper and is particularly effective when recorded in the writer's voice as part of a multimedia presentation. Students write the first drafts of their introductions in class, stressing their personal connections to their birthstones. Following the research outline helps students learn the basic report format.

Technology integration procedure

1. Students word process their handwritten research outlines.
2. Students continue to use search engines on the Internet to locate gemstone Web sites. They develop a file of scanned or downloaded birthstone images, and find short computer animations of birthstone formation. At this point, introduce and explain the concepts of copyright and intellectual property. Students can use a digital camera to produce original graphics. These resources are saved for use in students' multimedia presentations.
3. Using word-processing software, students create their first paragraphs by expanding their outlines. Voice-rich material, handwritten in English class, is added. Students use this basic procedure to develop all essays over approximately two weeks.
4. Once students have completed all their paragraphs, they assemble them into a formally formatted report (bound on the left). Teach advanced word-processing skills so that students can develop title pages, table of contents, page numbering, and bibliographical information.
5. After completing their reports, students begin their multimedia stacks. Use a rubric with performance expectations. Students design, animate, and test cards that present

significant research text. Require that students do a bibliography card.

6. After completing the multimedia stack, students produce a Web page that includes text from the formal report, links to the stacks, and an interactive 'Webliography' of sites with pertinent gemstone information. Students also create a cross-reference to other student-created sites for the same birthstone.
7. Organize a technology night for students to demonstrate and explain their presentations. Self-evaluation techniques that stress connections to NETS for Students and student performance can be shared and promoted.

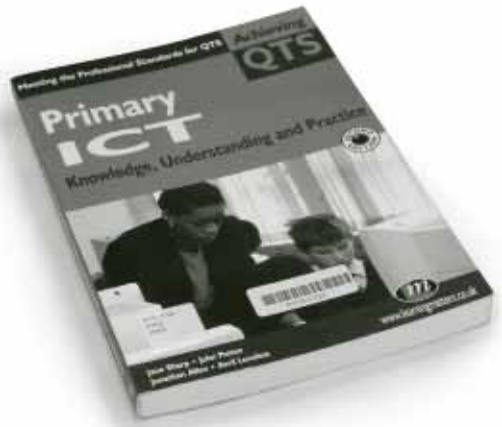
Science and technology procedure

1. Conduct a mineral lab to let students gather firsthand data about birthstones. Students analyze the results of the mineral lab and compare their results using a database. Information from the mineral lab is used in the second draft in the appropriate sections of the research reports.
2. The final deadline for typed research outlines is reached after approximately two weeks. Students submit their research outlines, which include endnotes and a bibliography. Outlines are reviewed by the teaching team and scored in science class for accuracy and completeness.

Keywords

English language arts; foreign languages; mathematics; science; social studies; ICT in the curriculum; pedagogy; standards; ICT integration

7. Sharp, J., et al. (2002) *Primary ICT: Knowledge, Understanding and Practice,* Learning Matters QTS Series. London: Exeter, 248 pp.



Type

Print publication (For orders, see http://www.learningmatters.co.uk/education/orders.asp)

Abstract

Part of the Learning Matters QTS (Quality Teacher Status) Series, this book has been prepared to support trainee and newly-qualified primary teachers as they develop an understanding of how ICT can enhance teaching. Features include:

- Links to English National Curriculum and Standards;
- Links with the Scheme of Work (UK) for ICT at Key Stages 1 and 2;
- Practical tasks providing a focus for further reading, observation, practice, evaluation and reflection;
- A clear focus on the core subjects.

Chapter 8, "Planning ICT in Subject Teaching," describes guidelines for using ICT in the core curriculum, moving from English and mathematics through to foundation subjects. Guidelines are divided under 'low resource' and 'high resource' headings, with ideas for activities and ways that ICT can support class work, practical tasks to help teachers with planning, and plenty of cross-references to National Literacy Framework (UK) and educational authority standards.

The following summary extracts the main points from this chapter:

English (Literacy Hour)

The author identifies the twenty minutes targeted for group work by the National Literacy Strategy as the ideal time for computer work.

Tips for low resource settings include:

Group work

- Where only one computer is available, creative planning will be needed, perhaps rotating small groups on a weekly basis
- Children not using the computer will need to be given relevant tasks to occupy them while waiting their turn
- The shorter time spent on a computer lends itself to certain types of tutorial software - CD-ROMs with short activities based around a particular learning objective, such as exercises to identify parts of words and break them down into constituent sounds

- Open-ended software like Word templates allowing children to search and replace nouns with pronouns can be useful
- In such cases, ICT can offer variety and stimulation for the children, and another option for the hard-pressed teacher

Plenary
- Teacher can lead a ten-minute reinforcement of learning objectives, using tutorial CD with revision games
- With appropriate software, children can prepare small presentations for the plenary session. This helps develop higher-order ICT skills, and reinforces the literacy learning point

Tips for high-resource settings include:
- If there is access to a network room, the entire literacy hour could take place there at regular intervals
- Plenaries could be held using large monitors, whiteboards or screen control software
- Language points can be presented to the children during the opening sections of the literacy hour using multimedia resources;
- Group activities to reinforce the learning objective using tutorial software (low-level ICT skills) or word processing activities (higher-level ICT skills)
- Group activities on search and replace, guided writing using palmtops (higher-level ICT skills)
- Collaborative work throughout the literacy hour on the learning objective using presentation software, word processing (higher-level ICT skills)

English (general and cross-curricular)
Children use English in a variety of cross-curricular ways, e.g.:
- Publishing a science write-up
- Creating a local-area guidebook in geography
- Writing school Web pages
- Generating captions to explain findings in maths data-handling
- Reading for information in any of the foundation subjects, science and math

The main issue in planning for these cross-curricular uses of English again relates to differing resource settings. Even in lower resource settings, however, there are options for ICT in the wider curriculum.
- Speaking and listening – children defend choices made in simulations and adventure games
- Whole-class reading sessions from a computer screen
- Word-processing for drafting documents and learning about the writing process

Excerpt

[revised] [pp175-181]

Mathematics

Again, the central part of the lesson lends itself most readily to integration of ICT. It is important to remember that the specific focus of the lesson on mathematics must be maintained, and the teacher has to draw the class together effectively during the plenary session at the end of the lesson. The flexible nature of mathematics classes means the teacher must be especially wary of the initial focus being lost through the course of the ICT-led activities.

The types of software that tend to lead to middle- and higher-order ICT skills in mathematics lessons are identified as follows:
- Software for transforming shapes;
- Data-handling software;
- Spreadsheets;
- Software for giving instructions of movement and turn in order to develop subject knowledge in, for example, measurement of distance and angle;
- Software for branching and sorting in order to develop logical thinking and problem solving.

While tutorial software seems to offer little in the way of ICT skills development, when its use is focused and targeted it can be extremely beneficial, especially in low resource settings. However, if used to reward or occupy children, this kind of drill and practice software cannot be said to help achieve meaningful learning objectives.

Science

Planning for science, perhaps more than other subjects, means identifying where technological tools will be an indispensable part of the learning process, where it is desirable, and where it will have no meaningful value at all. However, science shares with other core subjects the fact that some activities will not develop ICT skills to any real degree, for example tutorial-type CD-ROMs, while other tasks, such as the student

being required to set up and maintain a monitoring situation with technological tools, call for higher-order skills in both the target subject and ICT.

Guidance included in Curriculum 2000 from the UK includes the following:

At Key Stage 1, in learning how to recognise and compare the physical features of humans and animals, 'pupils could use multimedia sources to make comparisons'; also, in examining variation and classification, 'pupils could use data collected to compile a class database.'

While the first of these only employs lower-order skills, the second uses much higher skills, and there are strong links to core components in the Scheme of Work, in particular Labelling and Classifying and Finding Information. Questions the teacher needs to ask while planning these kinds of lesson are identified as:

- Is it the case that you need a context for developing the students' awareness of databases?
- Have they browsed CDs at length?
- Do you now need, in terms of the science, to deepen their awareness of subject knowledge in classification by asking them to work with the data they are collecting?

Additional links between science and the ICT scheme of work include:

- Materials and their properties – children can combine words and pictures about materials and objects on the computer;
- Physical processes – it is suggested that pupils use sensors to detect and compare sounds in their study of light and sound;
- Life processes and living things/Variation and classification – children could use a branching database to develop and use keys;
- Life processes and living things/Adaptation – children can use video or CD-ROM to compare non-local habitats; and use simulation software to show changes in the populations of micro-organisms in different conditions.

PRACTICAL TASK [p173]
Planning cross-curricular English outside the literacy hour

Consider a curriculum area in which you are expecting the children to write at the computer. It could be taken from [the following list]:

- Publishing a science write-up;
- Creating a local area guidebook in geography;
- Writing school Web pages;
- Generating a historical account;
- Writing about their beliefs in RE;
- Creating rules for classroom and playground behaviour in PSHE;
- Generating captions to explain findings in maths data-handling;
- Reading for information in any of the foundation subjects, science and mathematics.

Create a lesson plan which focuses on the specific areas of development of the writing itself which you are developing using the ICT.

Lesson overview
Include here the English element, the ICT element and the element from the other subject. For example, a lesson overview for 'Creating a local area guidebook in geography' for Year 4 might describe the ICT element as using desktop publishing software and digital images. The geographical element could be from the work on localities described in Curriculum 2000. The English element is the developing sense of audience and of how to present information in a clear and accessible manner.

Learning needs of the children
Note these in the cross-curricular context.

Grouping/timing
Think about different groupings from the literacy hour if your class employs ability groups. Children should experience a range of working partnerships and not always be grouped with the same children. We know from our understanding of the ways in which children learn that they need to interact with one another and learn in the context of talk with a whole range of peers of different abilities.

Resources
Make the most of information collected on local area trips, in particular, digital images, video clips and sound recordings which could be incorporated into the work on the computer. Consider working with a multimedia authoring package to produce a multimedia version of the guidebook if you are fortunate enough to be in a highly resourced setting.

NC/foundation stage context
One example for ICT could be from 'Finding things out' at Key Stage 2 – children should be taught how to 'Prepare information for development using ICT...'

For geography: from the Programmes of Study for KS – In their study of localities and themes, children should: 'study at a range of scales – local, regional and national...'

For English: from the Programmes of Study for KS2 – The range of purposes for writing should include: 'to inform and explain, focusing on the subject matter and how to convey it in sufficient detail for the reader...'

Make notes under the following headings:
Your own learning needs
Organisational memory joggers
Other adults
Learning objectives
Differentiation
Learning needs – Early learners
Learning needs – Special Education Needs
Assessment opportunities
Key questions
Lesson format
Evaluating the lesson part 1 – operational issues
Evaluating the lesson part 2 – learning outcomes
Evaluating the lesson part 3 – next time

Auditing
After the lesson, discuss the outcomes with your mentor and/or professional tutor. Try to assess the activity and see what it can add to your profiling. Have you provided evidence towards the standard for the use of ICT in subject teaching? Look at some of the following together:

'Is the trainee able to select and use software to support the teaching of the subject? Can the trainee access interactive online database content using, for example, the National Grid for Learning (NGfL) or the Teacher Resource Exchange (TRE) and select, customise and use these materials with pupils? Can the trainee provide opportunities for pupils to use ICT to find things out, try things out and make things happen? Does the trainee use ICT terminology accurately?'

(See these and more on p51 of TTA/DfES (2002) *Guidance on the Standards for Qualified Teacher Status*, TTA, Tunstall, P. and Gipps, C.)

Keywords
ICT in subject teaching; standards; staff development; ICT and curriculum; primary; classroom management; educational software

8. Starr, L. (October 2002) "Technology integration made easy." Education World.
http://www.educationworld.com/a_tech/tech146.shtml (2 March 2005)

Type
Online article

Abstract
This article from Education World is aimed at both teachers new to using technology in the classroom looking for some early guidance, as well as more experienced teachers needing ideas to integrate ICTs more fully into their teaching. These tips are subject-specific, and cover all the main curricula areas: geography, history, language arts, mathematics, modern foreign languages, social studies, and science. The ideas link to a broad range of websites, both education-specific and general sites, which contain useful resources that can easily be used for authentic, student-centred learning activities.

Excerpt
1. **Access online weather forecasts in French, German, or Spanish.**
   Begin foreign language classes with a discussion of the day's weather. The

Weather Channel provides weather information for Brazil, Germany, France, and Latin America in the native language of each country.

2. **Challenge students with online mathematics problems.**
   Add a daily or weekly mathematics challenge to your seatwork assignments, math lessons, or extra credit activities. The Math Forum's Math Problem of the Week offers word problems in five categories — math fundamentals, pre-algebra, algebra, geometry, and pre-calculus. The AIMS Puzzle Corner Math Challenge of the Month provides a monthly math-related puzzle that's appropriate for students in upper elementary grades and middle school. Most include printable worksheets. Aunty Math's Math Challenges for K-5 Learners offers biweekly word problems for younger students, while high school students will enjoy the news-related math problems at Math Counts, as well as Mike's Puzzle of the Week. Don't like today's problem? Not to worry! Most of the sites listed also include extensive archives.

   If you teach grades 3-8, extend your students' online math experience and encourage them to match wits with students around the world by participating in the Abacus International Math Challenge.

3. **Introduce a word of the day.**
   Extend students' vocabulary by including an online word of the day in opening activities, seatwork assignments, or language arts lessons. The Daily Buzzword at Word Central provides a word of the day and related activity appropriate for upper elementary students. Vocabulary Builder offers words and definitions for students in grades 4-6 and grades 6-9. The words and definitions at A Word a Day and Word of the Day are best for students in middle and high school. In addition, students in grades K-8 can safely extend their online experience by submitting phoney definitions to Fake Out.

4. **Keep them spelling.**
   Spelling isn't a subject that should die in elementary school. Prove it to your middle and high school students by adding spelling to language arts lessons or extra credit assignments. Each week, Carolyn's Corner offers a new list of "Paideia Words of the Week;" from the study booklet for the Scripps Howard National Spelling Bee. Invite your students to compete with the nation's best spellers!

5. **Make history real.**
   For many kids, history is only a subject in a book; one that's unrelated to real people, real events, or today's news. Personalize history lessons for those students by beginning each history lesson with a quick visit to Today in History or This Day in History.

6. **Utilize online work sheets.**
   Are you worn out from trying to come up with new and creative seatwork assignments day after day after day? Make life easier on yourself by including a few online worksheets. Each week, Education World provides an new printable Scavenger Hunt and a Writing Bug creative writing activity. In addition, Teach-nology offers lots of work sheets in a variety of curriculum areas. Or, add to the variety of your seatwork assignments by having students complete a weekly WebQuest.

7. **Beef up your history lessons.**
   Primary source materials adds interest to any history lessons; reading Thomas Jefferson's notes on the U.S. Constitution provides insights into U.S. history that a mere reading of the Constitution cannot. When planning U.S. history lessons, visit the Library of Congress's American Memory Collections search engine to locate primary source material for whatever topic you're tackling. Encourage students to include primary source materials in their history papers as well.

8. **Incorporate online news sources into discussions of current events.**
   Don't limit students' current events contributions to print newspapers; encourage them to search online media as well. CNN and MSNBC are excellent places to start looking for national and international news. Or, check out Online Newspapers to find your local newspaper online. The Internet Public Library also provides links to local news sources by country and, for the United States, by state.

9. **Make the news a learning tool.**
   Help students better understand current

events and connect today's news to their own lives by encouraging them to further explore the issues of the day. The Why Files, for example, uses news and current events as the basis for science, health, and technology lessons. What caused the tornado that devastated the Midwest or the hurricane that hit Florida? How does war affect those living in battle zones? What vote-counting technique is most accurate? The Why Files will explain it all. How Stuff Works also is an extensive site with information on a vast number of topics. Today's students, for example, might want to learn How Stinger Missiles Work, How Stem Cells Work, or How Hybrid Cars Work.

10. **Make science a daily event.**
    With the current emphasis on reading and math in schools, getting in a daily – or even weekly – science lesson can be difficult. If you're having trouble finding time for a more formal science lesson, take a minute to discuss NASA's Astronomy Picture of the Day or Goddard Space Center's Earth Science Picture of the Day, both of which include a brief explanation of the day's photo. You might also briefly discuss a scientist or a scientific event from Today in Science History or explore a Science Question of the Week.

Keywords
ICT in subject teaching; ICT and curriculum; independent learning; pedagogy; ICT integration

9. UNESCO. (2004) "Applying ICT to the teachers' subject area." UNESCO/International Federation for Information Processing Curriculum.

http://wwwedu.ge.ch/cptic/prospective/projets/unesco/en/teacherb.html (2 March 2005)

Type
Online article

Abstract
This resource describes the general competencies that all subject teachers must acquire to effectively integrate ICT into their classroom practice, as well as their broader daily activities, such as administration and training. There are guidelines for integration into specific subjects (languages; natural sciences; mathematics; social sciences; art), as well as student competencies with ICT, such as computer-led measurement, and creating graphics.

The general teacher competencies can be summarised in the following way:

Decision-making: to be able to make decisions about how, why and when ICT will offer genuine benefits to the learning objectives; to decide when different types of multimedia presentation - whole class or group - will be appropriate

Management: classroom management of students to achieve teaching targets; management of students with different ICT skills

Analysis of subject-specific software: CD-ROMs, hypermedia, websites, courseware, etc

Guidance: to equip students with Internet research skills, including management and criticism of information

Training/administration tasks: to be able to use technologies to collaborate in the improvement of teaching and learning (e.g. forums, bulletin boards, e-mail), and for management of learning processes

The pages describing ICT use in specific subjects also link to a wide range of additional guidelines relating to particular elements of that subject.

Additional general advice includes:

Emphasise generic, as well as specialist, tools to improve subject teaching;

Develop pedagogy alongside technical skills and confidence;

Don't be afraid to experiment more as pedagogy improves;

Use ICT in lessons that need improvement; in this way, if it goes wrong, frustration and insecurity over "messing up" a lesson is avoided.

Excerpt

[http://wwwedu.ge.ch/cptic/prospective/projets/unesco/en/social.html]

ICT IN SOCIAL SCIENCES

Composing Documents and Presentations (Unit A6 and Unit A3) and Information and Communication (Unit A7)

It motivates students very much to produce a report with ICT-tools on a topic in history, geography or economy. Students will appreciate ready-to-use graphics, photographs, pictures and other information which is available on the Internet about the topic. This application of ICT can be used to make a report on a certain topic, to give context to the subject discussed in the curriculum and to bring actuality into the classroom. Attention should be given to the problem that students just copy Web-pages into the presentation or use materials from other students.

Spreadsheets and Databases (Units A4 and Unit A5, Unit E1 and Unit E2)

In the study of social sciences, spreadsheets and databases serve the same purpose: to enable students to systematise and organise information. For example, students could make use a spreadsheet to make a list of dates, events, countries and persons involved. This list could then be organised by date, by country or by the person's name. Such lists make good study aids. Younger students like to collect information, and will enjoy setting up a database, for example on facts about countries in their region.

At a more advanced level databases and spreadsheets could be designed by the pupils themselves in order to help to solve a realistic and contextual problem (see Unit E1 and Unit E2).

Social and Ethical Issues and Professions (Unit A8 and Unit A9)

In the social sciences there is the best place to discuss ICT-topics related to the protection privacy and their attitude towards protection of data and copyrights. This is also a good moment for a discussion about the impact of ICT on society (changing and new professions, unemployment, economical value of ICT-investment, the so called "new economy", etc.). Students can learn here to deal with problematical information like racism, violence and they can obtain a better understanding of gender and intercultural issues. This can be reinforced by use of Internet (Unit A7).

Statistics (Unit B4)

Especially when studying Geography at an advanced level, students may need to use a statistical package.

Keywords

ICT in subject teaching; pedagogy; staff development; standards; administration; ICT integration

Requirements for and Barriers to Effective Technology Integration

1. British Educational Communications and Technology Agency. (January 2002) "ICT Supporting Teaching: Developing effective practice." Becta.

http://www.becta.org.uk/subsections/awards/practice_awards/documents/effectivepractice.pdf (2 March 2005)

Type

Online report

Abstract

This report from Becta is a contribution to the debate about what constitutes good classroom practice in terms of technology, and what factors determine the effective integration of ICT into the curriculum. There are links throughout to additional resources, many from the Becta site. The dominant theme developed in the report is that teachers who make effective use of ICTs: 1) set high targets of achievement with clear objectives for their lessons; 2) plan and organize timing and pace of teaching; 3) use a variety of teaching and assessment tools; and 4) create effective learning environments.

The following is a summary of the report's elaboration on these ideas:

Effective teachers support good practice by:

- **Setting high expectations:** Effective teachers communicate to students the targets they expect from them, and inspire them to meet those targets. Software, such as word processors, spreadsheets and databases, allow students to meet high standards of presentation without spending large amounts of time on low-level activity and, consequently, students show more commitment to their task and make more effort to improve the content of their work.

- **Having clear objectives:** Teachers who successfully integrate ICT into their classes tend to have clear teaching objectives and make explicit the relationship between those goals and the ICT being used to meet them.

- **Using a variety of teaching methods:** ICT allows teachers to cater to a wide range of learning styles, and students to learn at their own pace, as well as receive frequent feed-back and assessment.

- **Providing 'authentic' experiences:** The author cites the example of how students in a modern foreign language class can use CD-ROMs and interactive videos to interact with original source materials that can lead to deeper understanding and greater identification with their work.

Other areas the report identifies as essential to effective use of ICTs include:

Effective teachers assist the management of learning by:

- **Managing learning:** ICTs help teachers evaluate and monitor students' progress, automate some reporting tasks, and help set targets to develop practice.
- **Using a range of assessment methods:** For example, computer simulations offer new insight into student understanding, assessment software and, diagnostic tools as a part of Integrated Learning Systems.
- **Providing feedback:** Teachers can make good use of computers and related tools to provide fast and reliable feedback that is non-judgemental, impartial, and identifies student misunderstanding without de-motivating them. Teachers are also free to concentrate on developing students' higher-order skills.
- **Supporting planning:** Teachers can keep, share and access databases of lesson plans far more freely and quickly, with a large number of sites containing portals for lesson resources.
- **Managing time and pace well:** Teachers need to be able to know when to intervene in classes where students are using computers. Timely intervention can help maintain pace when, for example, students need help with problem solving or need more information.

Effective teachers promote an effective learning environment by:

- **Creating an effective learning environment:** Teachers must consider both the physical, as well as the virtual, learning environment. Among the many challenges, effective teachers teach safe behaviours in online learning alongside ensuring students work in a safe physical environment.
- **Extending beyond the lesson:** Many schools establish home access to their school intranet, so students and parents can access lesson plans, homework assignments and teacher feedback.
- **Celebrating success:** Showcasing student work online, for example, has proven to be a very motivating influence on the individual student, as well as on his or her peers.
- **Team-working and relating to others:** Effective teachers build good team spirit within the school and work well in collaboration with colleagues. ICTs can greatly enhance intra- and inter-collegiate collaboration, with online chat rooms and discussion forums allowing for ideas exchange and the easy sharing of lesson plans and resources.

Excerpt

Modelling effective behaviours

Effective teachers model the behaviours they wish to teach. For example, an English teacher may model the writing process using an interactive whiteboard. Effective teachers develop the necessary understanding through their own use of ICT. By being confident users of the technology, they act as role models to their pupils, moving beyond demonstrating techniques (such as how to use a search engine), towards modelling the process (of carrying out a search) with the class.

Greater familiarity with ICT places the teacher in a more effective position to support pupils' use of ICT and extend their own skills. It also increases the range of materials they can draw upon to integrate into classroom practice. By making these materials centrally available on school intranet or web sites, they can help build downloadable resources to support learning.

Keywords

essential conditions; classroom management; staff development; pedagogy; educational software; ICT integration

2. British Educational Technology and Communications Agency. (2003) "What the research says about barriers to the use of ICT in teaching." Becta.

http://www.becta.org.uk/page_documents/research/wtrs_barriersinteach.pdf (2 March 2005)

Type

Online report

Abstract

This report from Becta in the UK targets pre- and in-service teachers, identifying the following four types of barriers to effective teaching with ICT: resource-related factors; factors associated with training, skills, knowledge and computer experience; attitudinal and personality factors; and institutional factors. In addition, the report divides its findings into two broad categories, teacher-level barriers and school-level barriers, although it acknowledges that there is a complex interrelationship between the two.

The most cited barrier to effective technology use internationally is lack of equipment. That said, those most likely to complain of inadequate equipment tend to be the teachers using ICT the most, so this appears to be less a problem at the introduction of ICT stage than later down the line. Lack of equipment is an example of what some researchers define as 'external' or first-order barriers, in contrast to 'internal' or second-order obstacles. Other external barriers include unreliability of hardware and lack of technical support.

Second-order barriers include school-level obstacles, such as organizational culture, and teacher-level factors, such as personal beliefs about teaching and openness to change. Interestingly, research suggests that many first-order barriers, such as problems with reliability of computers, actually mask second-order factors, for example, lack of confidence or uncertainty about the relevance of ICT to a teacher's subject. Thus, the author emphasizes that first-order and second-order, as well as teacher-level and school-level, factors cannot be separated. In this way, one's attitude to ICT can both be a factor in its own right inhibiting ICT integration, and also contribute to other barriers.

The report notes that staff training must be tailored to the needs of the individual teachers, in some cases providing basic ICT skills before any talk of integration into the curriculum. One notable problem identified is that tutors on staff development courses often lack experience integrating ICT into the curriculum, and so pre-service teachers enter the classroom unable to meet the school's expectations of their actual ICT use.

Excerpt

Teacher-level barriers

- lack of time - for both formal training and self-directed exploration, and for preparing ICT resources for lessons
- lack of self-confidence in using ICT
- negative experiences with ICT in the past
- fear of embarrassment in front of pupils and colleagues, loss of status and an effective degrading of professional skills
- classroom management difficulties when using ICT, especially where pupil-to-computer ratios are poor
- lack of the knowledge necessary to enable teachers to resolve technical problems when they occur
- lack of personal change management skills
- perception that technology does not enhance learning
- lack of motivation to change
- long-standing pedagogical practices
- perception of computers as complicated and difficult to use

School-level barriers

- lack of ICT equipment, and the cost of acquiring, using and maintaining ICT resources
- lack of access to ICT equipment due to organizational factors such as the deployment of computers in ICT suites rather than classrooms
- obsolescence of software and hardware
- unreliability of equipment
- lack of technical support
- lack of administrative support
- lack of institutional support through leadership, planning and the involvement of teachers as well as managers in implementing change
- lack of training differentiated according to teachers' existing ICT skill levels
- lack of training focusing on integrating technology in the classroom rather than simply teaching basic skills

Keywords

essential conditions; ICT and curriculum; staff development; pedagogy; ICT integration

3. Cuban, L. (August 1999). "The technology puzzle," *Education Week* Vol. 18, No. 43.

http://www.edweek.org/ew/vol-18/43cuban.h18 (2 March 2005)

Type

Online article

Abstract

This article from *Education Week* identifies five alternative reasons for the apparent limited use of ICT in the classroom, particularly in high-schools, for anything more than low-end, administrative tasks. Initially citing the usual reasons given by industry experts, such as lack of training, too little time, the large number of older teachers and so on, the author then points out that in contrast to the small number of teachers who regularly use computers as an embedded part of their classroom teaching, a large number admit to using them at home, for lesson planning, online research, e-mailing etc.

This discrepancy leads the author to propose his alternative explanations. In brief, these are:

- **Contradictory advice from experts:** The author describes how the advice from experts about what teachers should teach in terms of ICT skills has shifted to a bewildering degree over the last two decades. First, teachers were told to teach BASIC to all students; then, it was applications, such as word processing. Next, they were asked not to send students to computer labs for specific training, but to incorporate the use of computers into their own classroom practice. Later, this involved learning and teaching HTML, so that students could create multimedia products. At the same time, they had to teach Internet research skills and applications relevant to the ever-changing working environment. The difficulties this creates for teachers is exacerbated by the following additional factors:
- **Intractable working conditions:** In contrast to most other work places, the teacher is asked to meet ever greater demands with no discernable shift in working conditions.
- **Demands from others:** High-school teachers have to juggle a large number of roles, from friendly and demanding teacher to disciplinarian and social worker, to subject expert.
- **The inherent unreliability of the technology:** Regular breakdowns are a severe test on the patience of even the most committed technophile.
- **Policy makers' disrespect for teachers' opinions:** Teachers are rarely involved in discussion as to which software, hardware and training are most suitable for them and their students.

Excerpt

The obvious question that seldom gets asked is this: Why should very busy teachers who are genuinely committed to doing a good job with their students listen to experts' changing advice on technologies when they have to face daily, unyielding working conditions; internal and external demands on their time and stamina; unreliable machines and software; and disrespect for their opinions?

Bashing teachers for not doing more with technology in their classrooms may give us cute media one-liners. What the one-liners miss, however, are the deeper, more consequential reasons for what teachers do every day. What corporate cheerleaders, policymakers, and vendors who have far more access to the media ignore are teachers' voices, the enduring workplace conditions within which teachers teach, inherent flaws in the technologies, and ever-changing advice of their own experts.

Such reasons are ignored because they go to the heart of what happens in schools, are very expensive to remedy, and reflect poorly on corporate know-how in producing machines. Nonetheless, these reasons may have more explanatory power for solving the puzzle of extensive home use of computers and limited, low-end classroom use than do the currently fashionable ones.

Keywords

essential conditions; staff development; infrastructure; policy/strategy; ICT integration

4. Department of Education, Tasmania. (February 2002) "Strategic Planning Framework: Strategic policy - ICT in schools, 2002-2005." DOE Tasmania: Education, Training & Information.

http://connections.education.tas.gov.au/Nav/StrategicPolicy.asp?Strategy=00000018&ID=00000145 (2 March 2005)

Type

Online document

Abstract

This document from the Tasmanian Department of Education describes in some detail five sets of requirements necessary for meeting its four policy goals for ICT integration into schools. Aimed at the classroom teacher, school principals and district-level curriculum planners, the report identifies as the major motives for ensuring effective use of ICT in schools: improving student outcomes; ensuring equitable access; developing required skills of school leavers; and adapting to the changing workforce.

The four policy goals that these sets of requirements target consider that ICT in schools will:

1. Transform elements of teaching and learning and act as a catalyst for other pedagogical, curricular and organizational improvements that expand opportunities for learning and improve student learning outcomes;
2. Improve the efficiency and effectiveness of educational delivery and school organization and management;
3. Facilitate the development of communities of learners, regardless of the personal circumstances or location of learners; and
4. Enable all students to leave school with the skills needed to participate fully in a knowledge society; become confident, skilled and critical in their use of these technologies; and be able to interpret information from a myriad of sources.

The five requirements for achieving these goals comprise:

1. **Creative, capable people:** In order for teachers and support staff to become competent, confident and creative users of ICTs with sound pedagogy, the document identifies the areas such as the following for focused attention:
   - Professional learning: including training targeting integration, as well as specialised instruction for teachers of ICT; sufficient time and opportunities for collaboration; relevant research.
   - Access to ICTs: budgetary priority for teachers to access appropriate technologies at school and at home; access for all students in all disciplines, as well as out-of-school access for students and parents.
   - Demonstrated competence in ICT a requirement for promotion.

2. **Supportive infrastructure:**
   - Planning: all schools maintain a current technologies learning plan.
   - Infrastructure: will be maintained and upgraded; a range of models to promote equitable access, with constant monitoring; a range of locations for using ICTs; budgets to focus on providing 24-hour access to staff and students.
   - Technical support will be of a high quality and available beyond school hours.
3. **Quality content and services:**
   - Curriculum framework to increase and improve students' ability to develop necessary basic ICT skills, and advanced skills that enable them to use ICTs critically and effectively;
   - Online content and delivery: innovative content designed and made accessible to all students regardless of background or ability; opportunities for distance online learning; strategic partnerships to help sustain quality of online content; develop means for online testing and adaptive assessment.
4. **Enabling policies and strategies, including:**
   - Congruent policy direction across all areas affecting ICTs;
   - Prioritised equity policy goals;
   - Policies for improving management and organization of school administration;
   - Access to state and national ICT projects;
   - Policies covering legal and ethical guidelines for ICT use.
5. **Practice which is informed by evaluation and research:**
   - Access to research information for teachers to evaluate their use of ICTs;
   - Efficient systems and tools that allow schools to monitor student learning outcomes;
   - Effective best practice implemented, based on national and international research.

Excerpt

Responsibility

The Deputy Secretary of Schools and Colleges will:

- Work with and support district superintendents, principals and teachers implementing this policy.

District Superintendents will:

- Assist principals in developing and maintaining Learning Technologies Plans, and ensure that they are congruent with other reporting and planning requirements.
- Recognise competence in the use of ICT in teaching and learning when assessing principals for leadership positions.
- Work with schools to ensure sufficient professional learning time for staff, enabling them to introduce ICT into teaching and learning including.
- Work in partnership with local businesses to identify strong and appropriate pathways from school to further education in ICT, or work opportunities within ICT industries within the district.
- Seek external partnerships in order to secure advantages in resource acquisition and strengthen pathways from school to work within the district.
- Support system-wide ICT in education evaluation programmes at a District level.

Principals will:

- Ensure that schools have a current Learning Technologies Plan in place.
- Recognize competence in the use of ICT in teaching and learning when assessing teachers for school leadership positions.
- Plan for increased professional learning time for all staff to ensure the integration of ICT into teaching and learning through the incorporation of ICT into school-wide professional learning provision.
- Plan for improved staff access to computers and the Internet within the school or college.
- Manage the development of ICT infrastructure, including purchasing and ongoing maintenance, with the assistance and support of IMB Branch.
- Seek external partnerships with businesses in order to secure advantages in resource acquisition and strengthened pathways from school to work.
- Actively engage parents and encourage their support for the use of ICT in their children's learning.
- Develop strategies to allow after-hours access to computers and the internet for students and parents, to not only access school ICT equipment, but to develop competency through tutoring/courses.
- Promote opportunities for distance online learning and school supported teacher remote online learning.

- Consider ways in which timetabling and school/college organisation can facilitate the effective use of ICT and vice versa.
- Actively participate in, and co-ordinate at a school/college level, evaluation of ICT use.

Teachers will:
- Keep informed about the potential benefits of ICT in their teaching practices and the ways in which this potential can be enabled, through professional reading, collaboration and professional learning.
- Plan for the use of ICT in their classroom and take opportunities to share/discuss their experiences with colleagues.
- Become familiar with online content that is available, through regular perusal of the *Discover* site, and consider ways in which this could be utilised in their teaching practice.
- Ensure that the *ICT in Education (K-12)* policy is reflected in their IPLPs and become involved in professional learning opportunities that facilitate the competent and creative use of ICT.
- Actively engage parental support for, and involvement in, the use of ICT in their children's learning.
- Participate in relevant evaluation programmes.

Teacher Librarians will:
- Keep informed about the potential benefits of ICT in their practices and the ways in which this potential can be enabled, through professional reading, collaboration and professional learning.
- Plan for the increased use of ICT in teaching and learning and take opportunities to discuss/share their experiences with colleagues and students.
- Become familiar with online content that is available, through regular perusal of the *Discover* site, and consider ways in which this could be utilised in staff practices.
- Support staff and student access to quality online content.
- Work with teachers in improving the ability of students to retrieve and critically analyse information, with an emphasis on web-based information.

Equity Standards Branch will:
- Support schools, colleges and online content developers in addressing the specific needs of those groups of students identified in the *Equity in Schooling policy,* in relation to access to ICT and usability of computing devices and online content.

The Office for Educational Review will:
- Develop ways in which data on student learning outcomes can be effectively and efficiently compiled and analysed.
- Ensure there is feedback to schools and colleges on the effects of their ICT practice on learning outcomes.
- Collaborate in ICT evaluation programs across schools and colleges.

Keywords

essential conditions; policy/strategy; evaluation; ICT and curriculum; administration; ICT integration

5. International Society for Technology in Education. (2000) "Section one: Connecting curriculum and technology - essential conditions to make it happen," in *National Educational Technology Standards for Students: Connecting Curriculum and Technology.* ISTE.

http://cnets.iste.org/students/pdf/ess_cond.pdf (2 March 2005)

Type

Online book

Abstract

This section, from the online book *Connecting Curriculum and Technology* from National Educational Technology Standards for

Students (NETS), describes the conditions necessary for effective use of technology in schools beyond the technology itself. Physical, human, financial and policy dimensions are all important for using ICT to enhance learning, teaching and educational management.

A combination of essential conditions is required to create learning environments conducive to powerful uses of technology, including:

- Vision with support and proactive leadership from the education system;
- Educators skilled in the use of technology for learning;
- Content standards and curriculum resources;
- Student-centred approaches to learning;
- Assessment of the effectiveness of technology for learning;
- Access to contemporary technologies, software and telecommunications networks;
- Technical assistance for maintaining and using technology resources;
- Community partners who provide expertise, support, and real-life interactions;
- Ongoing financial support for sustained technology use;
- Policies and standards supporting new learning environments.

Excerpt

The following chart lists characteristics representing traditional approaches to learning and corresponding strategies associated with new learning environments:

Traditional Learning Environments	New Learning Environments
Teacher-centred instruction	Student-centred instruction
Single-sense stimulation	Multi-sensory stimulation
Single-path progression	Multi-path progression
Single media	Multimedia
Isolated work	Collaborative work
Information delivery	Information exchange
Isolated, artificial context	Active/exploratory/inquiry-based learning
Factual, knowledge-based learning	Critical thinking and informed decision-making
Reactive response	Proactive/planned action
Passive learning	Authentic, real-world context

The most effective learning environments meld traditional approaches and new approaches to facilitate learning of relevant content while addressing individual needs. The resulting learning environments should prepare students to:

- Communicate using a variety of media and formats;
- Access and exchange information in a variety of ways;
- Compile, organize, analyze, and synthesize information;
- Draw conclusions and make generalizations based on information gathered;
- Know content and be able to locate additional information as needed;
- Become self-directed learners;
- Collaborate and cooperate in team efforts;
- Interact with others in ethical and appropriate ways.

Teachers know that the wise use of technology can enrich learning environments and enable students to achieve marketable skills. It is still critical, however, that educators analyze the potential benefits of technology for learning and employ it appropriately.

Keywords

essential conditions; policy/strategy; planning; staff development; standards; assessment

6. Knuth, R. and Rodriguez, G. (2000) "Critical Issue: Providing professional development for effective technology use." North Central Regional Educational Laboratory.

http://www.ncrel.org/sdrs/areas/issues/methods/technlgy/te1000.htm (2 March 2005)

Type

Online report

Abstract

This is a report from North Central Regional Educational Laboratory (NCREL) in the United States, which argues for the many aspects of teacher professional development as the key requirement for effective use of ICT in the classroom. It states quite clearly: 'The role of the classroom teacher is the crucial factor in the full development and use of technology in the schools (Office of Technology Assessment, 1995; Trotter, 1999).' Speaking to district heads and educational managers, the author sets out and elaborates on the many aspects of staff training that are an essential part of a school's technology plan:

- Connection to student learning
- Hands-on technology use
- Variety of learning experiences
- Curriculum-specific applications
- New roles for teachers
- Collegial learning
- Active participation of teachers
- Ongoing process
- Sufficient time
- Technical assistance and support
- Administrative support
- Adequate resources
- Continuous funding
- Built-in evaluation

The report also includes a wide range of references and links to relevant resources for further information and support, as well as video files featuring presentations from educational specialists.

Excerpt

Connection to Student Learning. The ultimate goal of professional development is to improve student learning (Speck, 1996). A study by the National Institute for the Improvement of Education (Renyi, 1996) found that 73 percent of surveyed teachers cited improved student achievement as the most important reason for participating in professional development activities. "Teachers value increased student achievement as an outcome of professional development more than any other variable and judge the value of their professional development activities by how much they see a leap in student learning," notes Lockwood (1999, p. 13). "Schools should provide teachers with abundant opportunities to become fluent in using technology to bolster instruction and help students develop higher-order thinking and problem-solving skills," notes the National Staff Development Council (1999). As a result, the use of technology enables teachers to implement new teaching techniques, to help students work collaboratively and develop higher-order thinking skills, to encourage students to be engaged in the learning process, to assist students who have various learning styles and special needs, and to expose students to a broad range of information and experts.

Hands-On Technology Use. Recent research has shown the importance of current professional development emphasizing hands-on technology use. "Teachers who received technology training in the past year are more likely than teachers who hadn't to say they feel 'better prepared' to integrate technology into their classroom lessons," notes Fatemi (1999). "They also are more likely to use and rely on digital content for instruction, and to spend more time trying out software and searching for Web sites to use in class."

Variety of Learning Experiences. "To help teachers incorporate technology in ways that

support powerful instruction requires an array of professional development experiences quite different from traditional workshops and how-to training sessions," notes David (1996, p. 238). Professional development for effective technology use can come in a variety of forms, such as mentoring, modelling, ongoing workshops, special courses, structured observations, and summer institutes (David, 1996; Guhlin, 1996). Whatever the format, effective professional development utilizes key points from adult learning theory. Adults require relevant, concrete experiences with adequate support, appropriate feedback, and long-term follow-up (Speck, 1996). This type of professional development is very different from traditional one-time teacher workshops. Research indicates that teachers learn and incorporate new information best when it is presented over a long time frame instead of a single session.

Curriculum-Specific Applications. If technology is to be used to produce improvements in student achievement, teachers must see a direct link between the technology and the curriculum for which they are responsible (Byrom, 1998). Professional development for technology use should demonstrate projects in specific curriculum areas and help teachers integrate technology into the content. In particular, professional development activities should enhance teachers' curriculum, learning, and assessment competencies and skills as well as classroom and instructional management competencies and skills.

Collegial Learning. A professional development curriculum that helps teachers use technology for discovery learning, developing students' higher-order thinking skills, and communicating ideas is new and demanding and thus cannot be implemented in isolation (Guhlin, 1996). In addition to working in pairs or teams, teachers need access to follow-up discussion and collegial activities, as required of professionals in other fields (Lockwood, 1999).

Continuous Funding. Finding the funding for ongoing technology needs and professional development can be difficult. School funding formulas that depend on residential property taxes and centralized purchasing and distribution policies may not be flexible enough to meet these new needs. Funding strategies that combine short- and long-term measures-including local tax revenues, bonds, grants, and federal programs-can help meet a school district's needs. Projects such as Taking Total Cost of Ownership to the Classroom can help planners determine all the costs involved in operating networks and computers.

Keywords
essential conditions; staff development; assessment; evaluation; policy/strategy

7. SEIR*TEC. (undated) "Factors that affect the effective use of technology for teaching and learning." SEIR*TEC.

http://www.seirtec.org/publications/lessondoc.html (2 March 2005)

Type
Online article

Abstract

This article describes findings from the United States where members of SEIR*TEC have been offering technical assistance and professional development to resource-poor schools in various aspects of technology integration. The observations and lessons learned are aimed primarily at policy makers, curriculum developers, principals and head teachers:

- **Leadership is the key ingredient**
  The document emphasizes that it is the states with the most visionary governors and legislators, and the schools with the most forward-thinking principals and curriculum developers that have the most successful technology programmes. Specifically, the authors point to the need for leaders: to have a clear vision of what is possible through the use of technology; to lead through example - the principal who expects to see ICT used seamlessly in the classroom while unable to send e-mails sends at best a mixed message; to support staff, and attend professional development sessions with faculty; to share leadership

roles and show trust in the decisions made by committee members.

- **If you don't know where you're going, you'll end up someplace else**
  The degree of success that a school has in implementing technology will depend, in part, on the quality and maturity of its technology plan. Each organization, whether it be a district or an individual school, needs to spend time developing and updating a comprehensive plan - starting with its vision, mission and goals. Every decision made should be one that supports the organization's vision.

- **Technology integration is a slow process**
  Studies show that integrating technology meaningfully into teaching and learning is a slow, time-consuming process, even for the most resource-rich school. Substantial levels of support for educators are needed as they go through predictable stages in their use of ICT, which typically takes between three and five years. Unsurprisingly, schools that receive the most attention, in the form of technical assistance and state-level support, tend to move faster along the learning continuum.

- **No matter how many computers are available or how much training teachers have had, there are still substantial numbers who are "talking the talk" but not "walking the walk"**
  Notwithstanding the inevitable differences between teachers in terms of their interest in new technologies, and their willingness to adopt these in their teaching, there are a number of strategies teacher trainers and principals can use to increase the likelihood of educators using ICT in the classroom. The article proposes the following:

  > Begin with teaching and learning, not with hardware and software; the training-of-trainers model means more than providing a workshop to a few people and expecting them to train their colleagues on what they learned; it's a waste of time and energy to provide technology training when teachers don't have the resources, opportunity, and support needed to apply their new knowledge and skills.

- **Effective use of technology requires changes in teaching, and the adoption of a new teaching strategy can be a catalyst for technology integration**
  Research shows that it is a combination of effective teaching and pedagogically sound technologies that leads to improvements in learning.

- **Each school needs easy access to professionals with expertise in technology and pedagogy**
  Teachers need on-site and on-demand technical assistance with both the technology and the integration of technology into teaching and learning. Finding professionals who have expertise in both areas is difficult, and few schools have professionals with both. Many districts hire curriculum specialists and technology specialists, and hope they work together. Sometimes they do; sometimes they don't.

- **Educators can benefit from tools that help them gauge the progress of technology integration over time**

Excerpt

As we have been helping schools implement their plans, we have noticed that there tend to be three areas of weakness. The first is a tendency for one individual or a few people to write the plan, a practice that flies in the face of the notion of stakeholder buy-in and community involvement. A second is that many plans lack a detailed component or plan for professional development that covers the broad range of skills teachers and administrators need. The third common problem is that most plans lack a component for evaluating the success and effectiveness of the program. The omission of components usually stems not from a lack of interest, but perhaps from a lack of expertise in how to set up an effective professional development program in technology, or how to conduct an evaluation that will yield meaningful and useful results.

One of our most recent observations originated not with the intensive sites, but with some technical assistance SEIR*TEC staff provided to the North Carolina Department of Public Instruction (NCDPI). The Department had asked for help in developing a way of collecting comparable evaluation data from 44 diverse Technology Literacy Challenge Fund (TLCF) grants. Working with DPI staff, we developed an instrument that has been adopted across the state, as well as in other states. We have observed that the instrument not only serves its original purpose, but also provides a non-

threatening framework for gauging a school's or district's progress toward technology implementation. Administrators report that it is a tool that helps educators reflect on where they are and where they need to go with their technology initiatives.

In the belief that helping educators reflect on their progress could potentially accelerate the rate of progress, we adapted the original instrument for use in the intensive sites. Basically, the adaptation involved the identification of five domains of technology integration, principles of good practice for each domain, and indicators of progress for each principle. Staff also compared the domains and principles with other instruments such as the CEO Forum's STaR Chart and the Milken Exchange's Frameworks for Technology Integration to ensure that ours covered all the bases. We just completed the first round of implementing the instrument in the intensive sites, and so far, the teachers and administrators have reported that in addition to being a useful gauge for progress in general, the instrument is a good basis for discussing specific technology initiatives across the district. It also helps them see the bigger picture of technology integration by showing principles of practice that they have not yet addressed. We will monitor the use of the instrument over the next several months and see whether it does indeed make a difference in program planning and implementation.

Keywords

essential conditions; professional development; standards; policy/strategy; planning

8. UNESCO. (2004) "Keys to Success: Lessons learned." ICT in Education Unit, UNESCO Asia and Pacific Regional Bureau for Education

www.unescobkk.org/index.php?id=1680 (2 March 2005)

Type

Online article

Abstract

These guidelines from UNESCO are intended chiefly for ICT programme planners and school principals, and identify a number of essential factors for and barriers to the successful integration of ICTs into education. The points mentioned include:

- technical factors
- co-ordination and integration
- teacher skills
- staff development
- the need for performance indicators
- time constraints
- the negative impact of high-stakes examinations on experimenting with innovative teaching tools
- the importance of adopting and following through a national policy.

Excerpt

Several technical factors can have a negative impact on the interactivity in learning. Virtual education might not flourish as expected because of disparities in bandwidth, cost of network access, presence of dedicated facilities, and limits on learners' access to necessary equipment including hardware and software; lack of system support to fast learners and slow learners; limitations on the current system of course credits transfer among institutions.

For e-learning programmes to work, there is a need to take into account the complexity of platforms, ISPs, firewalls, media selection, and portals, not to mention performance tracking and coordination with other curricula. This implies the need for a sophisticated management system to coordinate, integrate, and manage all the pieces that make up the learning system.

Teachers with only moderate skills in word processing, e-mailing and Internet surfing should avoid web-based education until they have gained a certain comfort level in the use of technology.

Successful use of ICT in learning is to a large extent dependent on teachers who used computers mostly for simulations and applications generally associated with higher-

order thinking.

Any project which introduces ICT use should include basic training in ICT literacy. Training should not only be limited to the basic use of computers but, more importantly, instruct on how to integrate ICT into teaching and curriculum development.

Success in the use of ICT can be measured if performance indicators are developed to monitor the use and outcomes of technologies and to demonstrate accountability to funding sources and the public.

Time constraints of classroom activities magnify problems with software configuration and similar start-up tasks. Students will often be limited to 30-40 minutes of computer access in a given class period. When students from different schools are working together, differences in class scheduling can diminish overlap and result in even smaller windows of opportunity for synchronous interaction.

The pressure of examinations distorts the open style of teaching and learning. It was found in country studies that teachers failed to implement student-centred teaching strategies because of high-stakes examinations.

Authoring of web content is still a single-user activity. When a collaborator opens a word processor on their machine, the application sharing software broadcasts a live image of the application to other collaborators. But at the end of the session, any saved files are available only to the user who started the applications or content.

One of the most important keys to sustainable technological innovation is to follow a thorough systematic approach, supported by a clear policy. A well elaborated national policy is seen as a prerequisite for countries to compete in the new global economy and knowledge-based society.

Keywords

essential conditions; standards; assessment; staff development; policy/strategy

1. Agodini, R., et al. (May 2003) "The Effectiveness of Educational Technology: Issues and recommendation for the national study." Mathematica Policy Research, Inc.

http://www.ed.gov/about/offices/list/os/technology/issues.pdf (2 March 2005)

Type

Online publication

Abstract

This draft report attempts to address the key questions and issues involved in a national study into the effectiveness of technology use in K-12 education. In designing such a study, a group of educational technology experts, policy makers and research specialists worked together to identify the core questions the study would raise and to suggest appropriate methods to respond to them.

In order to address the fundamental question, Is educational technology effective in improving student academic achievement?, the document proposes nine recommendations for addressing four more related questions: What is 'educational technology'? What is 'effective'? What kinds of students? What is 'academic achievement'?

Chapter 1, "Studying the Effectiveness of Educational Technology," elaborates on these questions, as well as on all nine recommendations. It also suggests key factors to be viewed in terms of their relationship to one another, which include teacher training and student characteristics, as well as those of their parents, teachers, classroom, school, district and local neighbourhood.

The rest of the report goes on to propose approaches for designing and conducting the study.

Excerpt

[pp11-15]

Design Team Recommendations for a National Study of the Effectiveness of Educational Technology

Question: ***What is "educational technology?"***

Recommendation 1: Examine technology applications designed to support teaching and learning.

Recommendation 2: Use a public submission process to identify technology applications to study.

Question: ***What is "effective?"***

Recommendation 3: Use experimental designs to measure effects.

Recommendation 4: Study the effects of technology applications for schools or teachers that do not currently use the applications, but are interested in using them.

Recommendation 5: Design the study to detect "moderate" to "large" effects of technology applications.

Question: ***What kinds of students?***
Recommendation 6: Study the effects of technology applications for students in the primary and secondary grade levels (K-12).
Recommendation 7: Study the effects of technology applications for schools that receive Title I funds.

Question: ***What is "academic achievement?"***
Recommendation 8: Study the effects of technology applications on student academic achievement as measured by commonly used standardized tests, and collect data on other academic indicators to provide a fuller picture.
Recommendation 9: Study the effects of technology applications that support instruction in reading and math.

Keywords

evaluation; educational technology; local educational bodies; staff development

2. British Educational Communications and Technology Agency. (2004) "ICT Advice for Teachers: A basic framework to study the impact of ICT on teaching and learning." Becta.

http://www.ictadvice.org.uk/index.php?section=ap&rid=1954&catcode=as_ass_02 (2 March 2005)

Type

Web page

Abstract

This is a timesaver from the British Educational Communications and Technology Agency (Becta), which provides teachers with a framework for monitoring the effect of ICT on their classroom teaching. It is composed of a series of templates that help teachers plan ahead for ICT integration, as well as monitor progress throughout the process to allow for lessons to be identified and research to be shared.

Action research essentially entails a series of cyclical phases, the evaluation of each of which informs the next phase. As every stage depends upon the careful assessment of the previous cycle, it is important to keep clear and relevant data throughout the programme's implementation. The following templates which are designed to help the teacher do just that can be downloaded:

1. Undertaking action research
2. Action research background information
3. Action research checklist
4. Action research contacts
5. Action research data collection
6. Action research planning sheet
7. Action research pupils involved
8. Action research purpose
9. Action research responsibilities
10. Action research timeline
11. Field notes record sheet
12. General structure for a research report

The authors suggest the following stages are key to successful action research, and many of these stages link to a specific template:

- Planning your research: this includes outline (100 words); timelines; contacts list; research and learning; field notes record sheet
- Establish the purpose of your research
- Formulate questions for your proposed research

- Specify the project background
- Consider ethical rules for school-based research
- Setting up the research: some decisions: What data will you collect: Who will you collect data from? In what form will data be collected? How will recording of data take place?
- Running the study
- Reporting your findings
- Finding the relevant literature: includes some useful links to websites and online resources

Excerpt

Template: Action research project checklist:

Action research project checklist

As you complete each of the following tasks, tick the box.

- ☐ Obtain consent for the study
- ☐ Book computers/ICT/computer suite
- ☐ Check that electrical/ICT equipment is in working order
- ☐ Obtain supplies of consumables, such as tapes
- ☐ Check that you are familiar with any software or hardware
- ☐ Check that you can obtain technical support, if necessary
- ☐ Produce and test your data collection instruments
- ☐ Keep a record of the contextual conditions existing before the study
- ☐ Check that your study is integrated into the school's planning
- ☐ Check that your pupils understand your aims for the research
- ☐ Check your own and your pupils' aims for their learning
- ☐ Organize classroom support, if necessary
- ☐ Check that everyone involved has a timetable for the study
- ☐ Check that everyone involved has contact details for one another
- ☐ Ensure that everyone involved is clear about the storage and retrieval system for data collected
- ☐ Build into the research timetable adequate time for analysis, reflection and discussion
- ☐ Organize a definite start and end point for data collection
- ☐ Decide who will write up the study
- ☐ Decide who will read and comment on drafts of findings
- ☐ Find a way to disseminate your findings
- ☐ Start (and keep updated) a research journal
- ☐ Set up a system for recording questions that arise during the study

Keywords

evaluation; policy/strategy; planning; data collection

3. Bond, T. (undated) "Why isn't it happening?" ICTNZ.

http://www.ictnz.com/Whatishappening.htm (2 March 2005)

Type

Online article

Abstract

This article suggests possible reasons why, despite a school having spent serious amounts of money on hardware, software and high-speed connections, there may be no discernible progress in student achievement. The author also proposes ways to ensure better returns on your investment.

Firstly, Mandinach's four stages of development with ICT are described as a way to assess how ready a teacher is to make use of technology in the classroom, and indicate what kind of help they may need to progress. This four-fold paradigm essentially can be outlined as follows:

1. **Survival stage**
   Characterised by the teacher struggling against technology; unable to anticipate problems; unrealistic expectations.

2. **Mastery stage**
   Characterised by the teacher developing coping strategies; increased tolerance and technical competence; more engagement.

3. **Impact stage**
   Characterised by a learner-centred classroom; the teacher as facilitator of learning; technology-enhanced curriculum coverage.

4. **Innovation stage**
   Characterised by a restructuring of curriculum and learning activities; modification of learning environment.

The author identifies four major aspects to be examined in situations in which there is little effective integration of ICT:

Infrastructure: Even the most ardent converts to technology will have their enthusiasm dampened if there are consistent technical problems with the computers.

Attitude: Some teachers will have a pre-existing aversion to technology in the curriculum, possibly because of bad prior experiences with ICT. Try and use the successes of other teachers to encourage them, and show what can be achieved, especially in terms of student and teacher motivation.

Understanding: Many teachers still think of ICT as a set of skills to be taught, rather than a tool to be integrated throughout the curriculum to improve student learning.

Professional development: Within this, there are two essential components: skills and ideas. Skills need to be developed in order to increase teacher confidence and competence, while ideas are essential to take some of the strain off the busy teacher. Furthermore, ideas act like seeds, and once teachers have been given a sense of what is possible they tend to come up with their own extensions and variations with little extra time needed after long days in the classroom.

Excerpt

A simple framework I find by which to evaluate integration of ICT into learning is to look and ask “What is the learning that this ICT-based activity is fostering?” Sadly, a lot of apparently flashy ICT use when examined this way, returns a nil answer.

A simple question I use to ascertain if there is an effective way of integrating ICT into any learning session is to examine the learning objective of the lesson and then ask “Is there any way ICT can help us to achieve this objective?”

If the answer is no... that’s fine, we don’t expect a carpenter to use a hammer when he needs to cut a piece of timber, so don’t expect the technologies to be used in every learning experience and during every part of the teaching day.

A simple guideline I use to govern the development of ideas is to construct an activity that has:

- A maximum of thinking for the pupils involved
- A maximum of discussion for the pupils involved
- A minimum of typing for the pupils involved

Keywords

evaluation; staff development; ICT in the classroom; ICT integration

4. Coughlin, E. and Lemke, C. (2004) "Technology in American Schools: Seven dimensions for gauging progress." Milken Family Foundation.

http://www.mff.org/publications/publications.taf (2 March 2005)

Type

Online document

[A condition for accessing this document is that no part of it will be reproduced. Type the title of the publication in the search field at the above URL.]

Abstract

This framework provides a set of indicators to help educators and policy makers assess a school's readiness to enhance the learning process through ICT. The seven interdependent dimensions are clearly laid out, and broken down into component topics. The dimensions comprise:

1. Learners
2. Learning environments
3. Professional competency
4. System capacity
5. Community connections
6. Technology capacity
7. Accountability

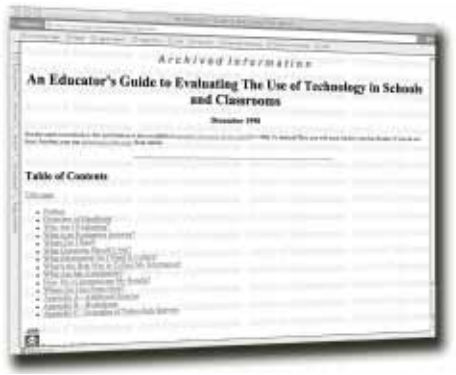
A core question under each heading leads into a series of important sub-topics on that theme. For example, the first dimension, 'Learners,' asks: Are students being encouraged to use ICTs to enhance their knowledge both of a particular curriculum subject as well as of the world at large? The sub-topics then ask whether students have developed sufficient fluency in their use of IT to perform whatever tasks that may require it; whether their use of ICTs then helps them acquire a deeper grasp of the basics of the subject studied; whether, by using ICTs, the students are able to develop higher-level thinking, learning and communication skills; whether their use of ICTs reflects real-life situations matches the ways professionals use the technologies in the workplace; whether access to ICT increases students' motivation to learn; and whether students are aware of the inevitable pros and cons in using technology?

Keywords

evaluation; indicators; infrastructure; policy/ strategy

5. Department of Education, United States. (December 1998) *An Educator's Guide to Evaluating the Use of Technology in Schools and Classrooms.* ED.gov.

http://www.ed.gov/pubs/EdTechGuide/index.html (2 March 2005)



Type

Online handbook

Abstract

This online guide to the evaluation process is aimed at educators and administrators at the district or school level. Interwoven among the tips and examples of questions to guide the reader is a sample evaluation from a 'real life' school district (Rivers School District), which is intended to inspire the user when developing their own evaluation.

The handbook chapters are organized around the following anticipated questions that those new to

making evaluations are likely to ask; within each section there are inside tips, and appendices contain additional sources and worksheets:

- Why am I evaluating?
- What is an evaluation anyway?
- Where do I start?
- What questions should I ask?
- What information do I need to collect?
- What's the best way to collect my information?
- What are my conclusions?
- How do I communicate my results?
- Where do I go from here?

In the chapter, "What questions should I ask?," the authors suggest starting by reviewing the programme goals (of the technology integration plan), to help clarify the kinds of questions you need to draw up. These goals may include, for example, teacher professional development to acquire the necessary skills to integrate technology in the classroom. Next, it is advised that you figure out what you want to know about the programme in orderto focus on the aim of the questions you ask: for example, do you want to know how frequently students use computers in the classroom or, perhaps, teachers' opinions of training programmes? Third, consider what other stakeholders would like to know from the evaluation: these may include the funding agency, state officials, legislators, policy makers, parents etc. Then, it is necessary to consider other requirements, in particular any strings attached to the granting of funding, such as what the money can or cannot be used to purchase, or the kinds of data and reports required as follow-up activities. Finally, the handbook suggests the all-important questions that relate to outcomes, such as, "Has student performance improved as a result of technology?," should be seen as long-term issues, which should neither be ignored as the practicalities of setting up technology programmes take priority, nor addressed too quickly.

Excerpt

What Questions Did Rivers Ask?

Kathy had already asked herself why different stakeholders wanted an evaluation and what they wanted from an evaluation. She had also come up with two major reasons why she wanted an evaluation:

- To find out if the programme is beginning to produce desired results (e.g., student reading scores are beginning to improve, professional development is effective, the programme is cost effective)
- To get information on the implementation process

Well, these reasons seemed very broad, so Kathy, using the general ideas and the list of specific things that others wanted from the evaluation, came up with general goals that people were interested in and, within these goals, more specific questions she wanted answered. The following is the result of her work:

After coming up with the questions above, Kathy reviewed them to determine if there was anything she was leaving out. She assessed her priorities and made sure they were included. She ran through her list of stakeholders – principal, superintendent, professional development co-ordinator, teachers, parents, herself. All stakeholders were accounted for. Finally, Kathy looked at the grant to see if there were any requirements she needed to assess. The grant was through the Technology Literacy Challenge Fund, so it was fairly

Goal	Question
Improved reading performance	Will the new technology and training help improve reading performance?
Improved dropout and attendance rates	Will the new technology and training help lower the dropout rate and increase attendance?
Cost-effectiveness	Will this programme be as or more cost-effective than other programmes that may show similar results?
Effective professional development	Will the professional development help teachers integrate technology into their teaching?
Increased computer literacy	Will students and teachers become more computer literate as a result of the programme?

flexible and many of the requirements were at the state level. Basically, one of the biggest requirements was that the district was responsible for reporting back to the state yearly on what they had done. In Kathy's opinion, assessing the goals that she had developed would satisfy the state. She would call her state technology co-ordinator to be sure, but it looked fine and she thought she was ready to further define her evaluation plan.

Keywords

evaluation; administration; data collection; staff development; policy/strategy

6. North Central Regional Educational Laboratory. *enGauge.*

http://www.ncrel.org/engauge/ (2 March 2005)

Type

Website

Abstract

enGauge is a Web-based framework from North Central Regional Educational Laboratory (NCREL) that identifies six essential conditions for effective use of ICTs to enhance student learning, and provides online assessment tools for evaluating a school's effective use of ICTs. The website comprises three main sections: the framework, itself, describing the key factors in effective use of technology for student learning; online assessment tools and surveys, as well as offline instruments, to gauge a school's use of technology, and to report progress; and a menu of research-based, technology supported resources that have been seen to work with students.

The six essential conditions that the online assessment tools translate into measures of effectiveness are: Vision; Practice; Proficiency; Equity; Access; and Systems. Each condition is presented with a number of indicators, which are then broken down into a series of components for more detailed discussion.

For example, the indicators for the condition Proficiency are identified as Skills; Planning; Implementation; Assessment; Productivity; Ethics. Each of these is then described in terms of, among other topics: Practice; Rationale; Success Stories; Roles; and References.

The online assessment allows nine different stakeholders to anonymously answer a set of questions on various topics relevant to that stakeholder, which then generates different types of reports that provide a system-wide picture of a school's use of ICTs. The nine stakeholders comprise: Educator; Student; Parent; Board Member; District Administrator; Building Administrator; Building Technology Co-ordinator; District Technology Co-ordinator; Community Member.

Excerpt

Selection of Sample Questions for an Educator from the Online Assessment
[*http://engauge.ncrel.org/survey/select.htm*]

Alignment to the Vision

How well is your classroom's technology use aligned to the school's or district's vision for technology?

- Not at all
- Slightly
- Fairly well
- Very well
- Don't know

How well is classroom technology use aligned with your district's standards?
Generally, throughout your school
- Not at all
- Slightly
- Fairly well
- Very well
- Don't know/No technology

How well is classroom technology use aligned with your district's standards?
Specifically, in the classes you teach
- Not at all
- Slightly
- Fairly well
- Very well
- Don't know/No technology

Learning Environment
Which best describes your school's readiness for helping students become increasingly self-directed as they progress through the grades?
- No explicit organized effort is made.
- We have some strategies in place.
- We have done significant work to encourage self-directed learning.
- We have a comprehensive program and are often looked to as a model.

Range of Use
Students in my school currently use technology:
- Not at all
- Very little or for one or two types of activities
- In a few different ways
- In a wide variety of ways

In your class(es), how often do students use technology for the following?

Drill and practice or tutorial (for example, math and reading games)
- Never
- Rarely
- Occasionally
- Frequently
- Does not apply

In your class(es), how often do students use technology for the following?

Expression/visualization (for example, graphing and charting, KidPix, Hyperstudio, PowerPoint)
- Never
- Rarely
- Occasionally
- Frequently
- Does not apply

In your class(es), how often do students use technology for the following?

Integrated Learning Systems (for example, Jostens, Plato)
- Never
- Rarely
- Occasionally
- Frequently
- Does not apply

Keywords
evaluation; data collection; indicators; policy/strategy; administration

7. Hopey, C., et al. (1996) "Evaluating the implementation of your technology plan." North Central Regional Technology in Education Consortium.

http://www.ncrtec.org/capacity/guidewww/eval.htm (2 March 2005)

Type
Online publication

Abstract
This is a page from the online document, "Guiding Questions for Technology Planning" from North Central Regional Educational Laboratory. The author emphasizes the ongoing nature of implementing technology plans, and the importance of continuing evaluation to allow for any necessary changes along the way. Various modes of evaluation are recommended, although the observations of teachers and students who have been using the technology in question are perhaps the simplest and most useful. In addition, informal meetings with teachers and students can help gather lessons learned, while written surveys can help keep sight of the targeted outcomes of the plan, and reveal to what extent they have been achieved.

Excerpt

The following questions should be addressed when planning to evaluate your technology plan implementation :

- How and when will you evaluate the impact your technology plan implementation has on student performance?
- Who will be responsible for collecting ongoing data to assess the effectiveness of the plan and its implementation?
- What windows of opportunity exist for reviewing the technology plan? (For example, the plan might be reviewed during curriculum review cycles.)
- How will accountability for implementation be assessed?
- How will you assess the level of technological proficiency gained by students, teachers, and staff?
- How will you use technology to evaluate teaching and learning?
- What is the key indicator of success for each component of the plan?
- How will you analyze the effectiveness of disbursement decisions in light of implementation priorities?
- How will you analyze implementation decisions to accommodate for changes as a result of new information and technologies?
- What organizational mechanism will you create that allows changes in the implementation of the technology plan and in the plan itself?

Keywords

evaluation; policy/strategy; data collection; planning

8. MIICE. (July 2002) "Measurement of the Impact of ICT on Children's Education (MIICE)." MIICE Assessment Toolbox.

http://sitc.education.ed.ac.uk/miicepresentation2/miicetoolboxes.html (2 March 2005)

Type

Online publication

Abstract

The Measurement of the Impact of ICT on Children's Education (MIICE) project brings together 17 Scottish education authorities and four teacher education institutes, whose initial aim was to produce a toolbox of measures for teachers and technology heads to plan and evaluate quality ICT programmes. The MIICE toolbox reflects the range of benefits that good use of ICT can deliver, by listing and describing 13 'learning outcomes' and their components, developed and validated by almost 250 teachers from a cross-section of Scottish schools. The project emphasises that these tools have been developed *within* the education profession, and are not just another set of targets drawn up by external authorities.

The 13 learning outcomes comprise:

1. Learner reflection
2. Skills development
3. Managing and manipulating digital information
4. Shared planning/organization
5. Investigatory learning
6. Shared learning
7. Motivation
8. Enhancing learning outcomes
9. Quality of outcomes
10. Self-esteem/confidence
11. Teacher use of computers as productivity tools
12. Teacher facilitation in learning ICT principles and good habits
13. Teacher use of ICT as a rich and effective means of learning

These, in turn, are grouped into three sections, relating to: the abilities and attitudes of the learner (numbers 1 to 7); the management of learning (numbers 8 to 10); and teachers' continuing professional development in ICT use (numbers 11 to 13). Each outcome consists of a number of questions, to be ranked from 1 to 4. For example, the second outcome, 'Skills development,' which relates to learners' development of systematic skills in using ICT tools for a purpose, is composed of three components: effective and responsible use of ICT; creation and presentation of their own material; collection and analysis of information.

The toolbox can be downloaded in summary form, or as full reports for either primary or secondary schools.

Excerpt

Group 2 - Relating to the management of learning

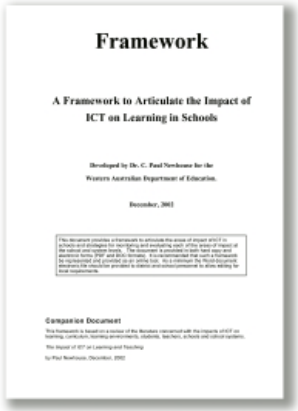
Outcome	Components
8 Enhancing learning outcomes [This relates to schools' , teachers' and school managers' focus on setting expectations for continuing but realistic progress in the uses of ICT and on putting it into a wider context]	Progression in learning Development of new teaching styles Enable learners to modify information in a variety of forms, including text, graphical objects, moving images, sounds and web pages Encourage development of informed attitudes in relation to ICT in society
9 Quality of outcomes [This relates to the setting and maintaining of high standards for learners by teachers and school managers]	Assessment policies Relationship to development planning priorities Planning of resources Breadth of experience of ICT use in context
10 Self esteem/confidence [This relates to the policies and practice of schools' , teachers' and school managers' in helping learners to feel a sense of community, to take pride in their work and to be willing to experiment]	Use of ICT to enhance school ethos Encourage pride in work Encourage enterprise and the exploration of new approaches

Keywords

evaluation; indicators; policy/strategy; standards; staff development

9. Newhouse, C. P. (December 2002) "A framework to articulate the impact of ICT on learning in schools." Western Australian Department of Education.

http://www.eddept.wa.edu.au/cmis/eval/downloads/pd/impactframe.pdf
(2 March 2005)


Framework

A Framework to Articulate the Impact of ICT on Learning in Schools

Developed by Dr. C. Paul Newhouse for the Western Australian Department of Education.

December, 2002

Companion Document

Type
Online document

Abstract
The author of this framework proposes a number of dimensions to consider when assessing the impact of ICTs on student learning. Three of these dimensions are developed in this publication, and are accompanied by relevant research questions and methods for measuring the impact of technologies on students' learning.
As far as the publication's strategies for measuring the impact of ICTs are concerned, the most relevant section is 'Measuring the Impact of ICT on Learning Environment.s. This addresses the Learning Environment Attributes dimension, the outcome for which is described in the following way: 'ICT is used to support pedagogic practices that provide learning environments that are more Learner-centred, Knowledge-centred, Assessment-centred, and Community-centred.' Nine indicators for this outcome are identified, along with relevant research questions, sample data-collecting instruments and methods for measuring the positive impact of ICT on students' learning environments.

A table lays out very clearly each indicator and its related research questions/methods of measuring impact. These methods tend to be one or more of the following: student activity logs; learning programmes review; lessons observation; and work samples of a random students sample. Each of these is described in further detail later in the manual.

The document also outlines the research questions and data-collecting instruments to address these questions, as well as providing some sample questions for teachers to assess the state of the current ICT learning environment.

Excerpt
Research Questions [p 17]

Investigate reality and build knowledge
In what ways, to what degree and how often have students investigated the real world using up-to-date information?
How have students used tools to build a broader and deeper knowledge base?
How has ICT been used, and how often, to investigate the real world and build knowledge?

Promote active learning and authentic assessment
In what ways, to what degree and how often have students been active as participants in their own learning and learn by doing rather than just listening or reading?
To what extent does assessment emerge from student activity compared with being an isolated activity?
How has ICT been used, and how often, to encourage students to be active as participants in their own learning and learn by doing?

Engage students by motivation and challenge
What level of engagement do students have with their own learning?
How have ICTs been used, and how often, to provide more motivating and challenging learning experiences that encourage students to be more engaged with their learning?

Provide tools to increase student productivity
What proportion of student time is spent on completing repetitive, low-level tasks

involving writing, drawing and computation that are not the main focus of study?
How has ICT been used, and how often, to increase student productivity, particularly with repetitive, low-level tasks involving writing, drawing and computation?

Provide scaffolding to support higher-level thinking
What proportion of student time is spent on higher-level thinking tasks such as application, analysis and synthesis?
How have ICTs been used, and how often, to support the development of higher-level thinking skills such as application, analysis and synthesis?

Increase learner independence
In what ways, to what degree and how often have students been encouraged to demonstrate independent learning and progress at their own pace?
How have ICTs been used, and how often, to provide learning experiences when and where they are needed?

Increase collaboration and cooperation
In what ways, to what degree and how often have students been involved in learning experiences involving cooperation and/or collaboration among learners within and beyond school?
What is the learning relationship between the teacher and students?
How have ICTs been used, and how often, to support learning experiences that involve co-operation among learners within and beyond school and a more interactive relationship between students and teachers?

Tailor learning to the learner
In what ways, to what degree and how often have students been provided with learning experiences based upon their personal learning characteristics and needs?
How have ICTs been used, and how often, to support more individualized learning programmes tailored to their individual needs, particularly in the case of students with special needs?

Overcome physical disabilities
In what ways, to what degree and how often have students with physical handicaps used ICT input and/or output devices to be included in learning activities with other students?

[Methods of gathering data] [p 23]

Work samples of a random sample of students
View a variety of student work and judge using the following criteria:
- Relevance and reality of contexts and opportunity to build own knowledge
- Productivity level of students, particularly with respect to low-level tasks
- Development of conceptual knowledge drawing on high level thinking skills

Student activity logs
Students keep log entries associated with:
- Relevance and reality of contexts and opportunity to build own knowledge
- Active and reflective processes supported and connected to assessment processes
- Productivity level of students, particularly with respect to low-level tasks
- Development of conceptual knowledge drawing on high-level thinking skills
- Degree of learner independence accommodated
- Support for collaboration and group-work

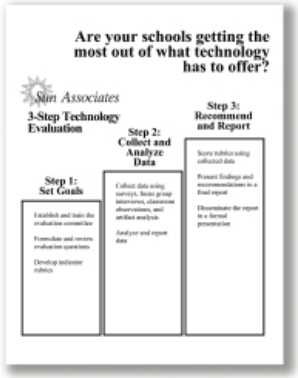
Review of learning programmes: Document Review
Judge using the following criteria ...
- Relevance and reality of contexts and opportunity to build own knowledge
- Active and reflective processes supported and connected to assessment processes
- Productivity level of students, particularly with respect to low-level tasks
- Degree of learner independence accommodated
- Support for collaboration and group-work
- Accommodation for differences between learners

Observation of Lessons
Judge a sample of lessons using the following criteria ...
- Active and reflective processes supported and connected to assessment processes
- Level of engagement of all students
- Productivity level of students, particularly with respect to low-level tasks
- Support for collaboration and group-work

Keywords
evaluation; data collection; indicators; ICT and curriculum; pedagogy

10. Sun Associates. (undated) "Are your schools getting the most out of what technology has to offer?"

http://www.sun-associates.com/3steps.pdf (2 March 2005)



Type

Web page

Abstract

These tips for technology evaluation come from a Sun Associates three-step scheme, which forms the core of a service the company offered to district leaders in the United States. These steps describe the process that Sun Associates follows when carrying out its evaluations, but the ideas contained here provide useful suggestions to anyone embarking on an assessment of their school's use of ICT for improved teaching and learning.

The three steps comprise: Step 1: Set goals; Step 2: Analyze data; Step 3: Recommend and report.

The procedure for Step 1 involves three further stages: establish and train the evaluation committee; formulate and review the evaluation questions; and develop indicator rubrics.

Step 2 calls for gathering data by using a variety of instruments, including surveys, focus groups, classroom observations and artefact analysis. Surveys may be of teachers, administrators, students or community members, and may make use of online or hard-copy media. Focus groups tend to involve interviewing teachers, administrators and technology staff. In addition to watching teachers and students using ICTs in the classroom, observations build up a broad picture of technology integration by also noting classroom setups, teaching styles and student behaviour.

Step 3 involves an additional three stages: scoring rubrics with the collected data; presenting the findings and recommendations in a final report; and disseminating the report in a formal presentation.

Keywords

evaluation; data collection; indicators; policy/ strategy

11. UNESCO. (2004) "Chapter 8: Monitoring and evaluation," *Integrating ICTs into Education: Lessons Learned.* Bangkok: Clung Wicha Press.

http://www.unescobkk.org/index.php?id=1793 (2 March 2005)

Type

Online book

Abstract

This chapter from a UNESCO resource on integrating ICTs into education responds to the perceived lack of monitoring and evaluation components in many countries' ICT programmes. Where such evaluations have taken place, often the results are not disseminated widely among the educational community.

Within this chapter, three aspects of evaluating ICT programmes are addressed:

documentation of ICT's benefits to education; evaluation methodologies; and programme evaluation. There are lessons learned for each of these components, which are described at the beginning of the chapter, and the text then draws on specific examples from the countries in the study to further elaborate helpful strategies and tips. The latter two components identify the following lessons learned:

Evaluation methodologies:

- Action research is one of the best methodologies for documenting the process of effective ICT integration;
- There are other means besides the paper-pencil test method that are more effective for assessing the impact of ICTs on learning;
- Both quantitative and qualitative methods should be used for assessing the integrated use of ICT in schools, using various means for collecting data, such as case studies, questionnaires, face-to-face interviews and focus groups.

Programme Evaluation: Evaluation should be continuous and cover all aspects of the process: planning, implementation, reflection, refinement, effectiveness, and user acceptance.

Excerpt

Lesson Learned 1

Action research is one of the best methodologies for documenting the process of effective ICT integration

One of the best methodologies for gathering data on the integrated use of ICT in Education is action research, as it enables practitioners to explore and integrate ICT in the school curriculum, reflect on the process and outcome, and amend and refine practices for future use.

a. ***Singapore***: edu.QUEST, an initiative of the MOE, showcased research projects on the use of ICT in Education. edu.QUEST projects focus on quality research on the impact of leading edge technologies on educational practices and achievements. Action research is ideal, as it is responsive to unanticipated discoveries in the course of experimentation with emerging technologies. In one such project at Woodlands Primary School, "Turning the Science Garden into a Huge Classroom" (http://www.moe.gov.sg/edumall/edu_quest/eduquester/sciencegarden.html), the teacher turned the school science garden into a huge outdoor classroom with students studying plants in their natural environment and surfing the Web on the spot for further research on the plants. The teacher's evaluation noted that (i) students can easily relate what they observe in the science garden to what they read on the Internet, (ii) students ask relevant questions and compare observations/findings with their peers, (iii) the learning environment is more interactive and responsive and, as the teacher is able to work with individual students or groups, immediate feedback and adaptive instructions are possible, and (iv) the Network Assistant package permits better management of tasks and the students. For example, it is possible to monitor and freeze the students' screens.

Lesson Learned 2

Assessing the learning impact from ICT use is better measured through other means besides the paper-pencil test method

There is a need for teachers to be trained on how to construct authentic assessment instruments and interpret the results, focusing on the development of student learning. Training should be a complete process of teaching and learning, as well as curriculum development. Assessment methods are new to most teachers and they would have to be trained to select methods suited to specific learning activities.

a. ***Thailand***: The new curriculum standards encourage the use of authentic assessment across the curriculum. The traditional paper-pencil test method is not responsive to an instructional process that focuses on students' learning, in which students are required to practice a higher level of thinking skills and to engage in hands-on activities to construct knowledge. Evaluation should be obtained from various sources of information and should make use of several methods (e.g. group or individual observation, report or product; interview; student's record; consulting between students and teachers; practical assessment; performance assessment; and portfolio assessment). An authentic assessment better reflects what students have learned or performed than the paper-pencil test method, and provides realistic feedback to both teacher and learner. The result of assessment can be cross-checked using several sources of information. A good paper-pencil test method is only able to assess rote learning and gives no information on what a student has learned.

Keywords

evaluation; policy/strategy; data collection; planning; ICT integration

Successful Case Studies of Technology Integration in Schools

1. British Educational Communications and Technology Agency. (2002) "Analysis of the Ofsted reports of schools that improved their ICT 1996-2000." Becta.

http://buildingthegrid.becta.org.uk/docs/Improved_schools.PDF (2 March 2005)

Type

Online report

Abstract

This report targets senior school managers and subject leaders for ICTs and aims to address the question: Can similar characteristics be found that account for the improvements some schools have made in their effective use of ICTs? The study comprises 20 schools: four special schools, one secondary and the rest primary schools. All the schools initially scored very low upon inspection of their ICT use in 1996-98, but achieved very good grades when re-inspected in 1998-2000.

Broadly speaking, three characteristics were identified as being present in all the improved schools: good leadership; good teaching and good resources. These and related questions, including recommendations, are described in the report.

Good leadership: Essentially, this entails the head or governor having a clear vision for how ICTs will help move the school forward, which is shared with the teachers. Many successful schools start small, focusing on phased, specific projects, and the vision should include how ICTs will shape the classroom, and what the 'delivered and received' curriculum will be for the students. Teacher confidence must be raised alongside student performance, and a gradual approach has been found to work best to this end.

- What is your school's vision for student learning and the classroom of the future in your school for 2004, 2007...?
- What implications does this have for your ICT policy and ICT development planning?

Strategic planning is then vital for turning vision into action. The report lists a series of important questions that can help with this stage, divided into the following areas: Vision and policy; pupil outcomes; curriculum implementation; resource deployment and management; information management strategy; finance; staff's continuing professional development; and parental and community involvement.

Curriculum planning: Plans should include an overview, as well as, medium-term planned activities. Plans should answer questions such as what will be assessed and how; and how ICT will be used to enhance and extend other subjects.

- How 'good' is strategic and curriculum planning at the moment?

- How do we monitor our practice so we know what pupils actually 'receive' and how well pupils are doing?

Staff professional development: Use of a selected software toolkit for staff training is often most appropriate for primary and subject-specific classes. Choose carefully the type of training model, and include support staff.

- How are teachers' and support staff's needs analyzed?
- What range of training is offered, and is it fit-for-purpose? Is teacher confidence and competence being raised? Is this reflected in classroom practice?

Resource management: Total costs of purchasing and maintaining ICT equipment are far greater than just the initial outlay. There are many hidden costs, such as training, cabling, Internet access, users' time, and technical support, that need to considered. The report recommends dividing an ICT budget into three areas: support, training and maintenance; hardware and networks; software and learning resources.

- How do you currently organize resources within the school? (Use of ICT suites, computers in classrooms or departmental areas?)
- Is there a better way to meet the vision, and what implications will this have on budget, use of rooms, infrastructure, timetable, technical support, staff training, etc?
- How do you acquire resources, and does this reflect real value for money when the total costs of ownership are included?
- What are your technical support needs, and how can they be solved?

Excerpt

[p. 4]

The table below highlights some questions to help with the review of planning:

Key area	Some possible questions to be considered
Vision and Policy	• What is it that the school hopes to achieve through the use of ICT? • How will ICT be used to raise standards both in ICT AND in other subjects across the curriculum? • Is the ICT development plan part of the School Improvement Plan, and does it reflect the schools' ICT Policy and the school's aims? • Are they regularly updated? • How are national priorities reflected? • How is best value secured?
Pupil Outcomes	• Are standards high enough? • What are the school's ICT targets for each key stage in 2002, 2004, 2007? • How do these link to national and local targets? • How is progress monitored, and is it on track? • What impact is ICT having on pupils' standards in other curriculum areas? • Is ICT used effectively to support all pupils, including the gifted and talented, SEN, EAL or those at risk of exclusion? • Does ICT impact on pupils' motivation to learn or satisfaction with school? (How do you know?)
Curriculum Implementation	• Does the Policy indicate how much curriculum time is allocated to ICT and how ICT is delivered? • Are there clear key stage planning over-views for whole-school delivery? • How will the national Key Stage 3 ICT Strategy be implemented? • Is ICT included in schemes of work for all subjects? • How are assessment and record keeping undertaken? • How are pupils' attainment and achievements reported? • How is curriculum implementation monitored? • What role is there for ICT homework? • What implications are there for out-of-hours use and home-school use? • If / How are resources shared with other schools? (What role for school website?)

Keywords

case studies; leadership; ICT and curriculum; evaluation; policy/strategy; staff development; pedagogy

2. British Educational Communications and Technology Agency. (undated) "Remodelling with ICT." Becta.

Type
CD-ROM (For orders, see: http://www.becta.org.uk/corporate/publications/publications_detail.cfm?currentbrand=2&pubid=59&cart=75)

Abstract
This CD-ROM contains case studies demonstrating how ICTs have helped reform teaching and learning practices in six schools in the UK. (The multimedia files require QuickTime 5 or above, which can be downloaded from the CD.)

Teachers, principals and ICT co-ordinators describe the effects that ICTs have had on their students and administration, and the multimedia format allows the viewer to see with greater clarity just how technology-rich classrooms can make a difference. Interactive whiteboards and Web cams are seen to offer real-time communication activities, administration staff describe the benefits of direct links to local education authorities, and the advantages to students with special educational needs (SEN) are described by one particular SEN-specialist school.

Illustrative examples include a school with a group of Year-5 students in a class with older students. They are now able to be teamed up with a larger class of their own age at a nearby school, and enjoy the range of lessons prepared by teachers there. At the same time, the older students at the first school can receive closer attention from their teacher.

It is hoped that the tips and recommendations contained in these studies can offer food for thought, and be adapted to individual schools' needs.

Highlights include:

- The need for technical support - teachers don't have time - nor often the expertise - to repair computers, and many schools now have ICT co-ordinators or managers whose specific task it is to maintain hardware
- ICTs do not reduce the teacher's workload, it changes the nature of the workload, and gives teachers more choices about how they work
- teachers can plan online, which allows them to access resources from home
- they can contact one another and parents much more easily by using database information
- ICTs allow for mix-and-match learning environments, useful for a 'plan B' when there is a serious shortage of teachers applying for vacant posts
- teachers can project onto large screens the teaching and learning objectives for a given lesson, so students know what they should have achieved by the end of the class
- students' data can be kept in a student achievement database, on which faculty directors can draw for monitoring
- ICTs can help with individual learning, especially important for students with special education needs.

Excerpt
[case study 3] "The children are so engrossed and motivated by IT and the resources cover so many curriculum areas. A wonderful example is World War II for Year 6: the teacher can lead with a video...and then the children can choose a club, a breakfast club or after-school club or Saturday club...to go revisit [the lesson], so they're continually learning independently."

Keywords
case studies; ICT in the classroom; educational software; special educational needs; independent learning

3. British Educational Communications and Technology Agency. (2003) "What the research says about strategic leadership and management of ICT in schools." Becta.

http://www.becta.org.uk/page_documents/research/wtrs_stratleaders.pdf
(2 March 2005)

Type

Online report

Abstract

This report, aimed at senior school managers and principals, summarises research into good leadership and management in schools through ICTs. It explains strategic ICT leadership as the need for school heads of the future to have knowledge and understanding in: how ICTs can support and enhance learning and teaching; how staff can be motivated to develop skills towards effective teaching through ICTs; how ICT resources can be developed and sustained; and how management information systems can be used to boost overall school performance.

The report describes the case of an award-winning head teacher-cum-ICT co-ordinator of a primary school in the UK. He has spent considerable time and money re-orienting his school and staff to focus on raising standards through the use of ICTs, and has introduced a number of innovative projects to that end. For example, with a strong emphasis on research, he has developed a project examining the impact of ICTs on the writing skills of boys at his school. He has also set up a link with a partner school in Hong Kong using e-mail, and loaded planning templates onto all staff laptops so that teachers can submit them electronically. In addition, all admissions, transfer and attendance data are gathered and stored electronically.

Having analyzed the research, this paper identifies five main common characteristics shared by leaders who, themselves, use and promote the effective use of ICTs for teaching and other tasks.

1. Vision: Senior leaders need to share with all levels of staff a constantly developing vision of the ICT role in education.
2. Personal Use: It is important that senior leaders are seen to be using technology in their daily working lives. In this way, they can become learners alongside students and teachers, and effect change in the whole school culture.
3. Continuing Professional Development: Senior leaders should be trained in more advanced used of management information systems; access to online support and the professional community can reduce their isolation and help them learn from the experience of others.
4. Management of Change: Innovative managers are using ICTs to create a whole new learning environment and experience for students. They need to be able to apply appropriate methods to the management of change.
5. Management Information Systems: School leaders require further training in MIS to fully benefit from the potential of these tools to help with the planning and evaluating of their schools' performance. Beyond the basic data-entry use of MIS, senior leaders can learn to use them for pupil assessment tracking and the creation of in-house reporting and recording software.

Excerpt

Factors for effective use

- A clear vision of ICT should be communicated to all levels of staff and the wider school community.
- Head teachers should personally use ICT to raise the profile of ICT in school.
- Educators should participate in online communities to help reduce professional isolation.
- Access development is needed to professional for strategic leadership of ICT.
- Effective use of management information systems is important to reduce the time spent on administrative tasks and provide useful data.

Key questions for senior leaders

- Do you and your senior management team lead by example in the use of ICT?
- Is ICT central to curriculum developments in your whole-school improvement plan?

- How well are teachers in your school supported in their use of ICT through continuing professional development, ready access to ICT resources and technical support?

How head teachers can embed ICT within teaching, learning, management and planning

- Develop a vision for the development and integration of ICT across the curriculum, and promote this vision within and beyond the school
- Provide appropriate, sustained ICT professional development for all levels of staff
- Become an ICT learner along with staff and students
- Use management information for school improvement
- Provide staff with personal access to ICT

Keywords

case studies; leadership; ICT and the classroom; staff development; ICT integration

4. Carr, J. (August 2002) "Project Pillars: Foundations for success in online curriculum projects." Education Network Australia.

http://production.edna.edu.au/sibling/pillars/default.htm (2 March 2005)

Type

Online report

Abstract

This is a paper describing findings from an Australian national project that aimed to establish factors for successful implementation of online projects in classrooms. Sixty teachers took part in the study, and data received from them forms the basis of the conclusions and good practice outlined here.

The three pillars for such projects are identified as: preparation, participation, and pedagogy, and are seen to provide the foundation for effective online projects. There are then a number of factors under the heading of each pillar that teachers who successfully implemented their project were seen to have taken into account:

Preparation

- Select: when selecting a project, teachers bear in mind a range of criteria:
  - Student needs
  - Student skills
  - Student interests
  - Learning outcomes
  - Technology requirements
  - Available support
  - Commitment needed
- Plan: teachers plan lessons with the project goals in mind
- Organize: materials and resources
- Support: for technology, participation and pedagogy
- Reflect: on planning before and during the life of the project

Participation

- Network: with other project participants
- Activity
- Manage: student learning experiences
- Extend ideas: develop project goals to meet student learning needs
- Evaluate

Pedagogy

- Traits
- Approach: many teachers in successful online projects exhibit strong constructivist leanings in teaching approach

- Mentor: teachers' reports often emphasize value of mentoring students
- Review: evaluation is critical for learning ahead of the next online experience

Excerpt

[*http://production.edna.edu.au/sibling/pillars/html/conclusion.htm*]
A way of looking at [successful teachers'] commitment is to do a comparison between sporting teams and conducting online projects. Players and coaches of sporting teams have an enthusiasm and zest for success. It is a powerful analogy that has value in online projects.

Coaching interventions/actions to increase success and improve learning outcomes

What coaches do before a sport event:	What teachers do before online projects:
• Analyse opposition. • Prepare game plan • Organise training sessions • Prepare equipment • Train players with skills needed • Train tactics and players roles • Gain commitment from players • Ensure players know rules and times and have right equipment	• Analyse project • Prepare curriculum unit • Establish student needs • Prepare technology and resources • Teach students skills required • Organise student/group roles • Gain commitment/motivation • Prepare timetables, checklists and technological support needed
What coaches do during an event:	What teachers do during online projects:
• Warm the team up • Provide equipment • Monitor player efforts • Provide feedback to players and umpire. • Provide tactics and changes where needed • Maintain motivation and enthusiasm in players	• Provide lessons for understanding and concept development • Ongoing student performance assessment • Communicate with students, project teachers and school staff • Adapt to suit project and student needs, develop extension activities where required • Build in fun
What coaches do after an event:	What teachers do after online projects:
• Analyse game and player' s performance • Check equipment and future needs • Plan future training and skill development	• Assess success of project and student evaluation • Feedback to school on future technology requirements • Consider student skills and needs and prepare next learning journey

Keywords

case studies; planning; evaluation; pedagogy; ICT in the classroom

5. Department for Education and Skills, UK. (undated) "ICT and Learning: ImpaCT 2 Study."

Type

CD-ROM (For orders, see: http://www.dfespublications.gov.uk/cgi-bin/dfes)

Abstract

This CD-ROM contains case studies from the ImpaCT 2 study conducted by the Department of Education and Skills and managed by Becta in the UK, which attempted to assess the progress of the ICT in Schools Programme. The study was designed to a) identify the impact of networked technologies on both school- and home-based learning; and b) ascertain the effects of these technologies on pupils' achievements at Key Stages 2, 3 and 4.

This report makes up one of three related strands to the study, and explores the nature of teaching and learning with technology in various in-school and home-based settings. This strand, thus, worked in 15 of the 60 schools involved in the larger research study, looking at learning and teaching environments, learning and teaching styles, and how the views of teachers, parents and students had been affected by ICTs.

Various research methods were used in a series of connected case studies, such as observations, interviews, video diaries and group activities, to determine the perceptions and understandings of the different people using ICTs in terms of their relation to teaching and learning.

The research was conducted under five main themes: ICTs in Schools: Practice and Perceptions; Management and Organization of ICTs; Technology and Infrastructure; Training and Professional Development; and Home and School Use of ICTs. The report describes the following key findings:

- Strategies for the effective use of ICTs for student learning are still developing.
- Sustainability and improvement of ICT provision are key. Many students have higher-quality hardware and software in their homes, and schools are often unable to afford the technologies they require.
- Many schools now have ICT suites, as well as stand-alone machines in various parts of the building. Teachers need access to computers for staff development and preparation.
- As students increasingly have access to better technologies at home, it is important that schools acknowledge pupils' innovative uses of ICTs and develop their own practices.

Excerpt

Summary of key recommendations from this strand

Training, guidance and support

- Whilst training to date has undoubtedly benefited teachers, there is a continuing need for training which can move beyond technical competence and concentrate on the appropriate application of networked ICTs into the curriculum, along with development of transferable skills such as search and evaluation strategies for both teachers and pupils.

Additionally, there is a need for specific guidance regarding the potential of ICT in the areas of numeracy, literacy and special educational needs (SEN), and more regard needs to be taken of the impact that ICT use in primary schools is having on secondary schools. There are clear opportunities for developing greater links between ways in which ICT is used in schools and the home environment.

ICT provision and support

- Dedicated staff machines and time should be made available to allow staff the opportunity for professional development and teaching preparation, and hardware and software need to be reliable, well-maintained and up-to-date in order to keep both staff and pupils motivated and effective.

Development and dissemination of good practice

- There is recognition among teachers that a more flexible approach is required if ICT is to be effective. Changes in lesson style to allow a less formal classroom atmosphere, greater pupil autonomy, differing modes of teacher/pupil interaction, and flexible study space are all recognized as key success factors for effective use of ICT. Further good practice should also be developed in facilitating greater links between home and school use of ICT.

Keywords

case studies; evaluation; pedagogy; ICT in the classroom; ICT integration

6. Espinoza, C. and Kozma, R. (March 2001) "Integrating technology into the curriculum to support standards-based achievements in a middle school." OECD.org

http://www.oecd.org/dataoecd/60/52/2740199.pdf (2 March 2005)

Type

Online report

Abstract

This case study describes 'an above average school in an above average school district,' a middle school in Colorado, United States. The wealth of information is of particular interest to school principals, curriculum developers and district-level educational managers, who will be able to see what constitutes successful use of ICTs in cross-curricular classroom practice from the perspective of this school's recent past, present and projected goals for the future. The school has a long past in recognizing the value of ICT for enhancing subject teaching, and teachers and students alike exhibit high levels of ICT skills in their daily practice.

The authors then propose five hypotheses concerning the role of ICTs in the school's success, as well as rival hypotheses, and use the information provided to support their conclusions as to which is the more valid. In brief, it was found that:

- Technology tends to be seen as an additional resource that supports standards-based, curriculum-driven instruction
- The distribution of technology users among the school's teachers contradicts traditional diffusion patterns for innovation - a far greater number of staff members are taking risks with technology than the traditional model would predict
- Extensive human infrastructure is central to the school's success with technology and with targets that are set;
- The school makes a strong case that ICT supports high academic standards.

Excerpt

[p 7]

The direct connection between these resources and the instructional practices of teachers and students was apparent during the site visit. While observing classes, both within the computer labs and other classrooms, the following technology-based practices were observed or described:

- Students in a 6th grade language arts class used the Internet to explore and evaluate various poetry websites and write their own poems for Internet publication.
- Students in a 6th grade science class used the Internet to gather information on the Alaskan tundra ecosystem, and used a variety of productivity tools to create a product, such as a newspaper, mural, or research proposal.
- Students in an 8th grade social studies class used the Internet to study court cases pertaining to one of the Bill of Rights that they selected, search for newspaper articles that pertained to this amendment, and construct a poster that explained how the amendment affects the lives of their classmates.
- Students in 8th grade used 'Blackboard', an intra-net collaboration environment, to share, read, and comment on each other's papers.
- Students in an 8th grade math class used 'Geometer's Sketch Pad' to construct geometrical shapes and dynamically explore their properties.
- An 8th grade student used a video camera and video editing software to make a report on tennis for a project in his inquiry class.

[p 8]

Hypothesis 1.

Technology is a strong catalyst for educational innovation and improvement, especially when the World Wide Web is involved.

The rival hypothesis is that where true school-wide improvement is found, technology served only as an additional resource and not as a catalyst, that the forces that drove the improvements also drove the application of technology to specific educational problems.

Evidence in support of Hypothesis 1.

By definition, technology plays a subordinate role at Clear Ridge and Mountain. The Principal and the Student Achievement Specialist characterized the innovation at Mountain as the integration of technology into the curriculum to support student achievement of standards. If statements like 'they couldn't have done it without technology' or 'that

wouldn't have happened without technology' are the criteria for evidence for a 'strong' role for the role of technology, there is little evidence that technology has played a strong role in driving changes in curriculum or instruction at Mountain.

The strongest comments about the role of technology in bringing about change were rather modest in claim. For example, when discussing the role of technology in the Proficiency Centre, the Principal commented on the ability of the software to differentiate the instruction around the needs of individual students:

> "A teacher can't have thirty different individual lessons happening in the classroom at the same time. So that's one of the beauties that I really see [in using technology]."

Or an 8th grade teacher said:

> "Our kids write so much more because they have technology to use in their writing."

Perhaps the strongest comment came from the Student Achievement Specialist, the technology coordinator, who said:

> "Technology can make things possible that nothing else can - writing for a larger audience. The creation of a web site so that other people can read what you're doing. . . Using spreadsheets to solve problems."

But even here, the Student Achievement Specialist subordinates her statement:

> "That will increase student achievement of a standard."

Evidence in support of the rival Hypothesis. More often, the comments made by administrators, staff, teachers, and even students suggested that technology was an added resource - an important resource, but just one more in an arsenal of resources that supported standards-based student achievement. The Principal commented that:

> "It's really enhancing the teaching of the standards . . . rather than just replacing something that they could already do in their classroom."

She went on to say:

> "It's just a different view of doing that, and so I think technology, if the teacher has that end in mind, then the technology can be just one of the tools to enhance them getting there."

The direction of impact is one of standards changing the use of technology, rather than the other way around. The District Technology Director, commented on the District's technology plan:

> "This plan also talks a lot about how [we] are going to be able to do the things that we know are right with kids for learning. Use technology to do that and within that embed the standards . . . and move toward where we need to be . . ."

Similarly, the Student Achievement Specialist stated:

> "Instead of what do you want to do and what program do you want to use, it's more what standards are you trying to address through this lesson, so it's changed the way that we plan."

The statements most often made by teachers were that:

- the use of technology enhances the curriculum
- it's an alternative way for kids to express themselves
- it can be used to do research in a slightly different way
- technology is always one of the choices for students

Teacher attitudes were best summed up by one 6th grade teacher who said:

> "Technology, I kind of feel, is a way to enhance my curriculum, because that's a conflict, I think 'does curriculum drive your instruction or does technology drive your instruction?' and of course, this being a standards-based school, I have to say my curriculum does."

Technology is important at Clear Ridge and Mountain Middle School, but it plays a supportive role and it is taken for granted in this community of frequent computer users. The Middle School Director, made an interesting comment on this topic. He said:

> "I don't view it [technology] as a change agent that we've introduced children to technology and then it's infused into the community. I just think that we reflect the community; the school reflects the community that it's part of."

Keywords
case studies; evaluation; ICT and curriculum; ICT in subject teaching; standards

7. European SchoolNet. (March 2002) "Education in eEurope - Innovative practices in schools."

http://www.eun.org/insight-pdf/practice_report.pdf (2 March 2005)

Type

Online report

Abstract

This online report describes and analyzes 50 innovative schools in Europe, identifying the common trends that they share and which together might inform schools ICT integration programmes in the future. The field research focuses on the dimensions of educational practice where ICTs can be seen to have had the most impact: pedagogy; economics; technology; socio-cultural aspects; and organization, and these categories determine the structure of the report.

The report also quotes research arguing that change must be seen to occur in three key areas before it can be deemed to be 'systemic' change: the possible use of new revised materials; new teaching approaches; and new beliefs.

Under the first dimension, pedagogy, the report distinguishes between two broad types of secondary school: technical and broad curriculum. The technical schools tend to show a uniform integration of ICTs across the curriculum, while schools with a broad curriculum often exhibit uneven use of technology, although they, too, were identified as displaying very innovative uses of their ICTs and of teaching practices, in general.

In the primary schools described, meanwhile, ICTs are generally integrated across the curriculum, rather than being subject-specific, and its use can be divided into three broad areas: as a medium of expression, especially because of its multimedia element; as a communication tool; and as a collaboration tool.

Many of the schools in the study reflected uncertainty as to the best ways to assess the benefits of ICTs in pedagogical terms. A number of new models for doing so are described in the report:

- The achievement model. This is generally used among secondary schools, where ICT is taught as a subject in its own right.
- The comparison model. Here, the achievements of classes using ICTs are compared to classes with no ICT element.
- The self-reflective method. Staff discuss students' responses to evaluation questionnaires.
- The public model. Schools assess the impact of ICTs on their pedagogical practice based on public and parent opinion, and media coverage.

Teacher training is also described under the pedagogical dimension. The majority of respondents quoted by the report cite self-training as the chief source of their learning ICT skills, while the next largest group point to in-service training.

The most striking aspect of the economic dimension of the report is the dearth of specific data provided by the schools themselves. Most schools in the study take part in funded projects or private projects supported by businesses or local communities, although the lack of reported data suggests teachers either do not see the connection between this funding and their access to ICTs, or else they play no part in the financial side of the job.

In terms of technology, many schools, while apparently still using what appear to be traditional computer labs, describe these computer centres in terms that make it clear they think of them more as specialist learning areas, where the computers are used as a learning resource for a particular subject. While student-computer ratios vary considerably, even among these schools, a high number of computers is not considered a major indicator of innovation; however, the teacher-computer ratio can be seen to have a direct effect on the level of innovative use of technology in the classroom. Hardware visible in photos and documentation includes scanners, printers, digital video and video conferencing equipment, while software is often very specialised, such as that used for specific subjects and share- and freeware, with the Internet often mentioned as a research tool.

The socio-cultural dimension of this framework highlights interesting patterns in gender analysis: specifically, while school principals and ICT administrators tend to be male, in best practice schools they are often female. The report stops short of drawing any explicit conclusions from this, but does make mention of other research suggesting that the hand-over of technologies control is often less when a male teacher is in charge of a largely female group of students. The report also notes that a) many best practice schools recognize the value of ICT in communication and thence collaborative projects, and b) two broad approaches to Internet security can be observed, generally dividing primary and secondary schools: supervision in the case of the former, and filtering in the latter.

As for organization, the study noted the role of the ICT co-ordinator (very often also a teacher) who must work with many other stakeholders to formulate policy, implement programmes, and deal with maintenance and servicing, which in turn has led to a greater school-wide reliance on teamwork. In addition, the changing role of the teacher and principal is recognized, with most best-practice schools tending to be supported by visionary and proactive leaders. Such leaders often try to find new ways of approaching traditional aspects of school life, such as the linear timetable and conventional uses of space. In this way, they can be seen to encourage and embody innovative approaches to getting the most from new technologies.

Excerpt

[Technological dimension - p. 43]

3.2 Distribution and Access of Computers at School

In the questionnaires, we have asked "Where are computers used mainly in your school?" The results were perhaps predictable because primary schools have generally less laboratories than secondary schools. However, less predictable is the picture of what are today classified in innovative schools as "class rooms" and what as "laboratories."

In the grid for delivering the "ICT How and Where" documents, we have asked for pictures of any rooms where computers are used and we have suggested a list of "traditional" school rooms. Of course, computer rooms, laboratories and classes were among the suggested rooms, but we got a lot of questions from teachers: some schools responded that they have "no laboratories," others that they have "only laboratories" because each subject is taught in a dedicated "subject room." The computer room, when present, and the "mediatec," a media rich library mentioned by Rugkobbelskolen or Zernike College, were at the beginning the only room in the school with any computers. Now, in these same schools, these areas are more used for extracurricular activities of students, for teacher training, or for users from outside of the school.

Independently of school level, it is reported by the schools that "normal" teaching happens in "equipped rooms," where students can work together in groups, where the teacher is not an exclusive "information source," where pupils are supposed to do actively something and not just to listen to or to deliver written or verbal presentations of their knowledge and skills. Computers are an important part of the equipment of these new "learning rooms," but they are not the only tools available or used.

Schools without laptops use "mobile computer stations" (e.g. Dietrich Bonhoeffer Gymnasium, Germany) and wireless technology will delete the feeling of the "punishment corner" given by some l-room-layouts (e.g. Istituto comprensivo Jesi Centro, Italy or Carmen Sylva High school, Romania).

With a "normality" attitude, computers are present in the most advanced and also richest schools in "leisure" rooms for teachers and pupils. Even if games are not often permitted in primary schools, these have never been presented as rooms for learning, but rather as rest rooms.

3.3 Maintenance and Repair

An intelligent use of old computers increases the number of available machines. So, for example, at Rugkobbelskolen, "*The computers placed in classrooms are mostly older computers working as MS Terminal clients connected to our Terminal Server – and this way, all our oldest computers live a few years longer in a very efficient way*." Or at Dietrich Bonhoeffer Gymnasium the "old computer room" is used as an ICT area where students can use computers whenever they want. Old computers are also the "desired object." For the most original "dream room" of our sample, we have encountered such a "dream" at ITIS Vivante, Italy: "*Our dear older PCs have not*

yet retired! They are stored, waiting to help us in a project by using Opensource (Linux) software."

For primary schools and for the not technical secondary schools, the repair of computers is still a problem even when external firms and local support are available. The external support is expensive (Røyse skole, Norway) and the internal one never sufficient because it is entrusted to already busy teachers (Realschule Graz-Weibling, Austria, Ecole Elementaire De Belb ze les Toulose, France, Astrid Lindgren Grundschule, Germany, Scuola Media Dante Alighieri, Italy). Original and effective solutions are presented by those schools, which give a more relevant and innovative role to pupils. So, for example at the computer repair rooms of Åmot ungdomskole, Norway, *"The students can choose between some subjects at our school. One of the subjects is 'ICT in Practice.' In our school we have a room where a group of students works with upgrading and repairing of the computers used by the entire group of students at school. In the process, we are now starting a service store for helping other students."*

Computer repair has become a lucrative activity for students of Sekundare schule Minerva, Switzerland: They are in charge of repairing school computers and get financial compensation for it! For students of the Belgian St Vincentius Handelinstituut, computer repair has become part of their curriculum: *"The students of Computer Management have in their timetable 2 hours practical training or seminaries. We fill this among other things, by providing ICT-support in the primary schools of Deinze (5 schools)... They also make an inventory of the hardware and software in the school, and they give a lesson about a subject chosen by the teachers. For this lesson, they write a manual for the teachers."*

The same happens to students of the Italian ITIS Majorana, but pupils of the Belgian St Amandus need no help:
"Children love working with the computer. Kids like to pass on their knowledge and skills to other children. Pupils can also take over a few computer jobs from their teacher, such as: starting the computer, choosing the right programme; or installing a CD-ROM. In this way the teacher has more time for the other educational duties...Real educators can still learn a lot from their pupils...A pupil who renders assistance to the teacher or a friend may wear the yellow cap of the @-team!"

Keywords
case studies; evaluation; leadership; pedagogy; infrastructure

8. Harris, J. (1998) *Virtual Architecture: Designing and Directing Curriculum-Based Telecomputing.* Eugene OR: ISTE, 148 pp.

Type
Print publication (For orders, see the ISTE Bookstore at http://www.iste.org/bookstore/)

Abstract
This book from ISTE is aimed at K-12 teachers, curriculum developers, staff development specialists, teacher educators and pre-service teachers. Its main theme is telecomputing projects, and the author outlines the essential stages that lead towards effective, curriculum-based activities integrating technology, in particular the Internet, into any K-12 classroom.

The book presents this process by employing the extended metaphor of building and

exploring a house, from laying the foundations, through exploring the internal space in which various tools are used in different ways in different parts of the house, to looking at the larger picture, such as the land and context in which the house stands. There are also detailed descriptions taken from case studies illustrating the author's main points.

Thus, Chapter 5: Telecollaborative Projects in Context, considers three important elements of educational telecomputing projects, 'exterior' elements. These are addressed in the form of the questions: How do such projects 'interface' with the rest of the curriculum? How can students' project-based work best be evaluated? How can the efficacy of project designs be assessed?

One of the problems associated with using the Internet for developing student-centred, problem-based, multi-modal and interdisciplinary projects is the question of time. The author argues that it isn't the Internet, itself, that requires more time, but rather teaching well which demands the teacher's resources. The suggestion is that projects such as these could combine curricular goals, as well as activity structures, to counter curricula crowding.

The case study that illustrates best practice in this regard comes from a project involving Grade 6 students in Canada and the United States. The project, entitled "Learning: The Next Generation," began by exploring answers to two questions: "What will schools be like in the 21st Century" and "How will students learn and teachers teach?" Although the students used various telecommunications tools - for example, groups of students creating Web pages to introduce themselves, including links and extra information - the focus of the activity was on problem-based, collaborative learning. The students worked towards creating and sharing architectural plans and essays describing the experience of going to school in the future.

These students could be seen to have engaged in various kinds of learning, including information exchange, parallel problem-solving and electronic publishing. In answer to the question of what curriculum targets the project met, the author refers to a page combining various sets of professionally-developed standards within each subject with specific skills and strategies: "Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education" (*www.mcrel.org/standards-benchmarks/*).
These reveal that the students involved in the Next Generation project had addressed 10 out of the 13 general standards identified for language arts. In addition, the project also addressed standards relating to mathematics, problem-solving, geography and interpersonal skills.

As far as evaluation of student learning and assessment of project designs are concerned, the author notes that it is the individual project that should be assessed, not telecollaboration in general. That said, there are four different forms of assessment that are relevant to evaluating students' learning:

- Performance-based assessment
- Authentic assessment
- Portfolio assessment
- Journal assessment

Another case study is then described to show how several of these types of assessment can be used. Assessment of project design, meanwhile, should be no different for a telecollaborative project than for any other student-centred, multidisciplinary learning experience. The excerpt below elaborates on this.

Excerpt

[p 127]

Assessment of project designs

I have asked many different groups of teachers throughout the United States and Canada to determine, as a group, what the characteristics of powerful educational activities are, whether the activities incorporate the use of the Internet, or whether computers in general are used on the activities. Here, for example, is a list of characteristics [of attributes of powerful educational activities] generated by a group of teachers participating in a symposium at McGill University in Quebec:

Attributes of powerful educational activities:

1. student-centred
2. authentic
3. builds independent thinking skills
4. creative
5. students have significant ownership
6. collaborative
7. open-ended
8. self-assessment is incorporated
9. students learn from other students
10. intrinsically motivated
11. addresses differences

12. interdisciplinary
13. inclusive
14. process oriented
15. fun
16. instant feedback
17. learning is interactive
18. active participation
19. non-threatening
20. up-close and personal
21. challenging
22. meaningful

[...]

Here's another list, developed by a group of educators at a state-wide conference in Iowa. Attributes of powerful educational activities:

1. freedom of inquiry
2. exhibited to the world/audience
3. problem-solving
4. active involvement
5. higher-level thinking
6. students finding own resources
7. students making connections
8. real-life
9. collaborative
10. independence in learning is encouraged and demonstrated
11. interdisciplinary
12. multiple solutions to problems are incorporated into the design
13. students given options for assignments
14. multiple intelligences are exercised
15. fun
16. meaningful

What kinds of overall patterns do teachers see in these lists of characteristics? A group of teachers in Honolulu, Hawaii offered these ideas with reference to the attributes that their groups named:

Themes:

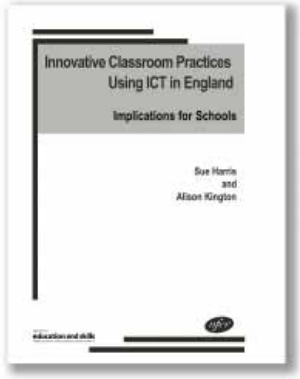
- conflict/resolution; problem-solving; challenge resolution; tension/release
- student-driven or student-generated; teacher-guided; teacher-facilitated; teacher-generated but student-driven; student as worker, teacher as coach
- engaged learner; students and teachers enjoy what they're doing
- creative
- communication
- risk-taking
- decision-making
- student takes responsibility for preparation
- use of prior experience in present learning
- co-operation/collaboration

Keywords

case studies; evaluation; collaborative projects; independent learning; standards; assessment

9. Harris, S. and Kington, A. (2001) "Innovative classroom practices using ICT in England: Implications for schools." National Foundation for Education Research.

http://www.nfer.ac.uk/research/downloads/12.PDF (2 March 2005)



Type

Online publication

Abstract

This is the preliminary summary of a study carried out in the UK by the National Foundation for Educational Research on innovative pedagogical practices using ICT. Schools were selected for the study based on the following criteria: innovative classroom practices that utilized ICT; evidence of improving standards; levels of resources which could be achieved by other schools; and a favourable Office for Standards in Education (OFSTED) report.

Three primary and three secondary schools were chosen for the case studies, and each demonstrated how ICTs, when appropriately used, can have a significant positive impact on students' learning. Outcomes included

improved motivation; increased confidence and self-esteem; enhanced social skills; improved group-working and co-operative skills; and enhanced achievement.

The implications of ICTs on the schools involved redefined roles and greater demands on both the teachers and students. Teachers, for example, found they had to develop their own ICT skills, show willingness to re-examine and change their approach to teaching, support the students, and monitor and evaluate the new activities they had introduced. Students, on the other hand, found they were being asked to show greater responsibility for their work, meet deadlines and become more reflective about their performance. Despite these changes, however, the teachers involved in these case studies all expressed the view that the greater workload was justified by the outcomes, and were keen to continue the initiatives.

Four factors were identified by the case studies as being essential to the successful introduction of ICTs by the teachers:

- That they had prior experience in some form of innovative programme (not necessarily related to ICTs)
- That they enjoyed support from senior management
- That they worked together in a collaborative environment
- That they were willing to take risks, aware that some initiatives would inevitably fail

Some examples of innovative activities in primary schools include the following:

- Pupils were given all-day access to a PC, and worked on a variety of assignments that involved web-based work. Pupils with special educational needs were especially motivated to produce work of a higher standard.
- One school set up an e-mail exchange between pupils and staff at a local phone factory, encouraging writing for authentic communication.
- Older children in another school worked collaboratively on a series of cross-curricular problems and puzzles, developing a range of ICT skills while the teacher played a supporting, but not a leading, role.

Excerpt

The innovations in secondary schools 'Turning potential into performance': Using a database to record, monitor and set targets

A secondary school collected data about students' performance in formal tests and ongoing work in all subjects, and used this to set targets for students. A computer database stored this data for approximately 2,000 students in the lower and upper schools. Teachers used the data to give them a better picture of each student's capabilities and to prepare differentiated tasks for students of different abilities. Students who were underachieving received additional attention and support. Students were motivated by knowing that their teachers closely monitored their performance.

An online course leading to accreditation in ICT

Upper secondary school students worked on a two-year online course which led to formal accreditation in ICT at 16+ (an intermediate General National Vocational Qualification: equivalent to four GCSE passes at Grades A-C). The materials had been prepared by staff at another school in accordance with syllabus requirements, and offered to other schools for an annual fee. Students worked independently at school and at home using multimedia resources; teachers supervised their work at school and marked the formal assignments. The online course delivery was viewed as an attraction for de-motivated students.

Using video conferencing to improve English students' conversational skills in French

Upper secondary school students practised their conversational skills in French by participating in video-conferencing sessions with students in a French school who were studying English. High-ability students volunteered for optional lunchtime sessions for 20 minutes each week for ten weeks. The teachers collaborated to prepare sheets for each week to guide the conversations. Students spent half the session asking questions in the other language, and half the session answering questions in their native language; they liked seeing as well as hearing the reactions of the other students.

Keywords

case studies; innovative practices; pedagogy; ICT in the classroom; ICT and curriculum

10. Kozma, R. Ed. *(2003) Technology, Innovation and Educational Change: A Global Perspective.* Eugene OR: ISTE, pp. 301.

Type

Print publication (For orders, see the ISTE Bookstore at http://www.iste.org/bookstore/)

Abstract

Chapter 7: *"Stellar Cases of Technology-Supported Pedagogical Innovations*" provides an analysis of 22 stellar cases of ICT integration chosen from the 174 cases in 28 countries featured in the rest of the book. The summary of these 22 exemplary cases includes an overview of the schools; a look at the ICT used and the demographics of each individual school; and the pedagogies used in each innovation.

The author notes that by nature these are examples of innovations and, thus, it is very difficult to categorize them in any satisfactory way. Many even used a range of pedagogies simultaneously. That said, most used pedagogies characterised by authentic instruction and student-centred learning, as well as using instructional methods like project learning, inquiry, alternative assessment and collaborative learning.

The 22 cases represent countries from all over the world, and illustrate wide variety in the pedagogical innovations they employ. Examples include:

Networked Cultures and Communities

- A group of eight schools, some of which are in remote communities, who set up an electronic magazine for sharing their experiences.
- A networked community of five primary schools in Spain, in which students developed multimedia resources reflecting research (conducted by Internet searches, field trips and digital photography) describing the geography, history and culture of their villages. Their work was also integrated by their teachers into specific subjects, such as geography and history.
- The Salt Flat project, a website developed by a single school in Israel, that took a cross-curricular approach and resulted in an online learning centre containing student projects, information banks with historical and geographical data, visual content and study aids (including activities for special education and resources for immigrant students).
- The *Luring into Reading Through the Internet* innovation in a German primary school, through which pupils collaborated with students in the Czech Republic, Sweden and Hungary on projects that used fairy tales in an interdisciplinary way 'to stimulate students' pleasure in reading and to advance creative writing.' Pupils wrote new fairy tales or rearranged and modified existing tales, using a mix of traditional and ICT-based media and exchanging materials with students from the other schools. Teachers noted the students exhibited greater attention to style and readability of their stories as a result of the international exchange.

Virtual Field Trips

- A laptop-based art project in Hong Kong, in through students used art software, such as Painter Classics and Art Dabbler, to learn about the effects of different art media. Specially-selected students travelled to Beijing to work with mainland Chinese pupils; to learn Chinese painting techniques and critique one another's work; to teach them how to sketch with laptops; and to learn how to collaborate with students from another culture;

Pioneering Projects of Teachers

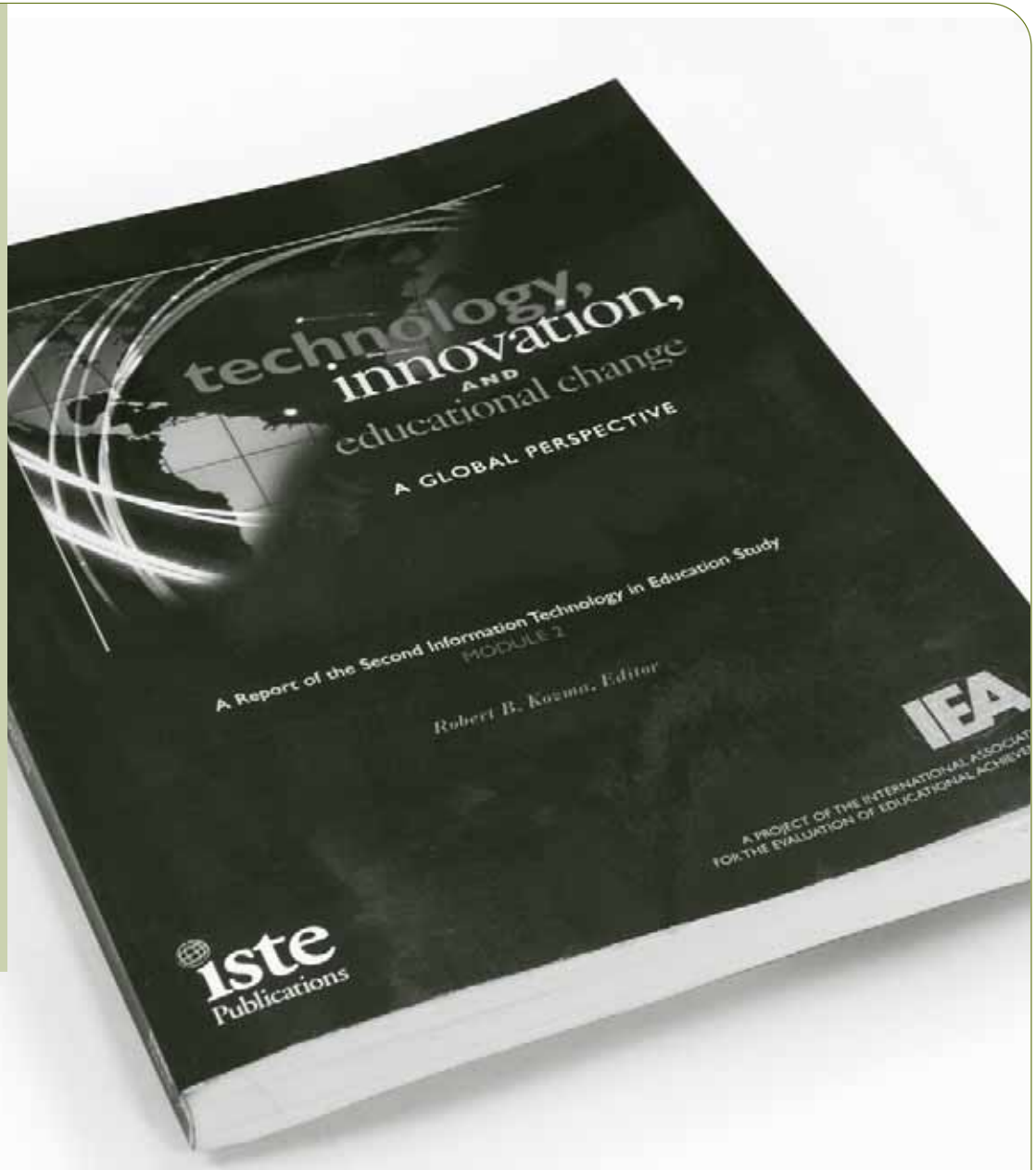
- A poetry-composition project in Thailand, through which a teacher developed CAI programs to teach pupils to compose Thai-language poems. Students work together by answering questions, performing exercises, and coming to consensus after discussing their differing views. Communication between students and the teacher takes place on the Web Board developed by the teacher, and the pupils can access verses online for studying. They then compose a poem and enter it for submission on the website.

Excerpt

[p 211]

Large Cross-curricular Projects

In Portugal's stellar case, all primary school students in the third and fourth years worked in small groups throughout the school year to develop school cinema projects. The project was called "Image in Movement: Young Cartoon Directors." The students used ICT for the entire process of producing an animation, including image capturing and script design. A major pedagogical focus was upon skills in plastic expression and in the critical evaluation of audio-visual messages. Art was one of five subjects in the curriculum; the ICT-based animation activity was allocated two hours per week for the entire year. Each classroom was guided by a three-teacher team consisting of (1) the main teacher of the class, (2) the teacher co-ordinator who gave assistance primarily with the ICT, and (3) the teacher in charge of 'visual and technological education, who helped with plastic and visual expression.' The latter two teachers came into the classroom for the weekly two-hour session. The students generally worked in groups on their animation projects. The students learned to use Director and Premier software in order to produce animations. Some of the resulting animations were extraordinary for ten-year-olds.



Keywords

case studies; innovative practices; pedagogy; collaborative projects; independent learning; ICT and curriculum

ACRONYMS

The following acronyms are used throughout the catalogue:

BECTA - The British Educational Communications and Technology Agency (UK)
CBT/CAL - Computer-based Teaching/ Computer-assisted Learning
DfES/QCA - Department for Education and Skills/The Qualifications and Curriculum Authority (UK)
DTI - The Department of Trade and Industry
GCSE - General Certificate of Secondary Education (UK)
GIS - Geographic Information Systems, tools used to gather, transform, manipulate, analyze, and produce information related to the surface of the Earth
HTML - Hyper-Text Mark-up Language, the authoring language used to create documents on the Web
ICTs - Information Communication Technologies; the term used to describe the tools and the processes to access, retrieve, store, organize, manipulate, produce, present and exchange information by electronic and other automated means
IMB - The Information Management Branch, The Department of Education (Tasmania) - http://www.education.tas.gov.au/admin/ict/default.htm
ISP - Internet Service Provider, a company that provides access to the Internet
ISTE - The International Society for Technology in Education (USA)
KS - Key Stage (UK) – Under the UK National Curriculum, primary and secondary education levels are divided into four stages, after each of which students take examinations. The Key Stages are: Key Stage 1, Ages 5-7; Key Stage 2, Ages 7-11; Key Stage 3, Ages 11-14; and Key Stage 4, Ages 14-16.
LCD - Liquid Crystal Display, a type of display used in many portable computers
MI - Multiple Intelligences (see page 37, entry 12 for more)
MIICE - The Measurement of the Impact of ICT on Children's Education Project - www.miice.org.uk
MOE - Ministry of Education
NCREL - The North Central Regional Educational Laboratory (USA) http://www.ncrel.org
NETS - The National Educational Technology Standards (USA) http://cnets.iste.org
OFSTED - The Office for Standards in Education (UK) - http://www.ofsted.gov.uk/
PC - Personal Computer; often used to mean an IBM or IBM-compatible personal computer, as opposed to other types of personal computers, such as Apple Macintoshes
PE - Physical Education (UK)
QTS - Quality Teacher Status
SEIR*TEC - The SouthEast Initiatives Regional Technology in Education Consortium (USA) www.seirtec.org
SEN - Special Education Needs (UK)
URL - Uniform Resource Locater, or Web address
VSAT - Very Small Aperture Terminal, an earthbound station used in satellite communications of data, voice and video signals, excluding broadcast television

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