



Revolutionising e-Education  
**Initiatives:** Maximising ICT  
Investment to Deliver e-Learning  
with Industry Standard Solutions



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# Revolutionising e-Education Initiatives:

Maximising ICT Investment to Deliver e-Learning with Industry Standard Solutions

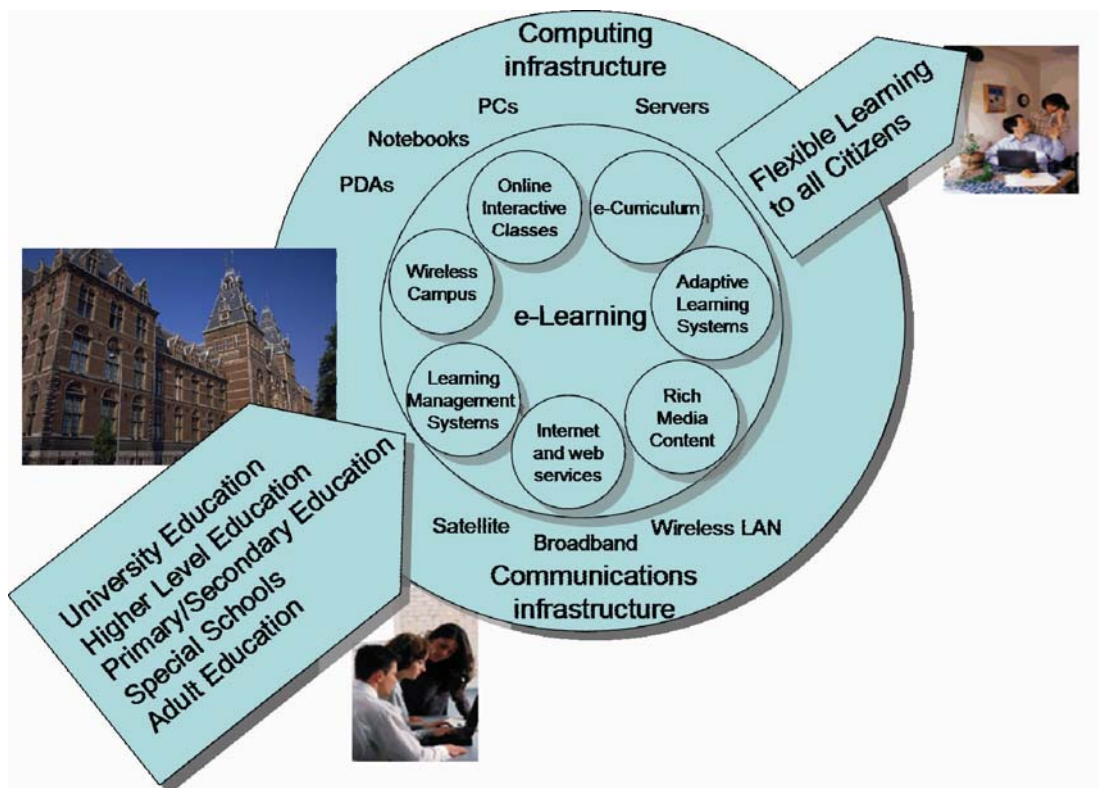
## executive summary

Education is the foundation of any modern society; e-Education is the next evolutionary step.

E-education is the delivery of education by electronic means using formal teaching methodologies and styles. E-Learning is a generic term which encompasses the learning channels and systems such as remote delivery of multimedia content, email, video conferencing, online interactive classes and learning management systems.

E-Learning is increasingly being used in commercial organisations to improve efficiency and reduce costs. This ranges from simple video and animation clips which provide on-the-job training, to fully interactive training courses that lead to professional qualifications. E-Learning is now being adopted and integrated into mainstream education.

Governments that embrace innovative technology can significantly improve educational standards and computer literacy, enabling their respective countries to compete effectively and take a lead in the global marketplace. E-Learning caters to all types of educational environments and individual learning needs, affecting educational establishments, teachers, pupils, students in higher education, and adult learners. E-Learning will also have a pronounced impact on teaching methods and instructional delivery.



The technology to provide a core e-Learning environment is readily available and consists of:

- Tools to develop rich e-Learning courseware and experienced vendors to build the content.
- Scalable, cost effective Intel architecture-based servers to store and process the content.
- Internet and wireless LANs to deliver e-Learning content.
- Desktop PCs, notebooks, tablet PCs and handheld devices to access the e-Learning content.

Intel's expertise in adaptive e-Learning, school community e-Learning systems, educational research with universities, worldwide teacher technology education programs, and collaboration with many government computing and networking suppliers uniquely positions Intel to advise governments on how innovative technologies can enable significant improvement in educational standards and PC literacy.

The arrival of high quality e-Learning content aligned to national/regional school curricula and, potentially, areas of higher and adult education, presents an opportunity for centrally managed e-exams and reduced administrative overhead.

National/regional e-Learning content can be delivered to individuals either remotely or within a classroom environment. This approach introduces flexibility in the learning process and extends learning time beyond the classroom which better accommodate students with a range of abilities and work/life schedules.



## E-Learning: The Evolution

The pressure on governments around the world to improve services to citizens and businesses and to increase internal efficiency is driving the adoption of new Information and Communication Technology (ICT).

The challenge of improving education services and better managing teaching resources is an issue that all governments face. Governments and educational establishments around the world are embracing e-Learning systems based on scalable, cost effective industry standard Intel architecture-based hardware, open industry standards and the Internet.

### Business Drivers

Education is high on both the citizen and government agenda. From a citizen's perspective a good education and qualifications can directly improve job prospects and quality of life.

Governments are also committed to promoting higher skill levels within the population, since a well-trained, digitally literate workforce represents a major economic advantage to the country. The result is that governments need to provide improved education opportunities and raise student achievement within schools, as well as cope with greater numbers of students going on to higher education and university.

To meet citizens' expectations and governments' own aspirations cost effectively, e-Learning must become a key element of school, higher level and adult education.

Today e-Learning is used effectively in an increasing number of commercial organisations and governments, alongside conventional methods; there is also an emergence of e-Learning systems being adopted by governments as they begin to realise the benefits for students and teachers.

### E-Learning Potential and Opportunities

E-learning offers a number of key advantages:

- E-Learning allows learning to be undertaken from anywhere at anytime. This may remove the need to physically attend a course, eliminating travel time and costs. It also allows community e-learning education centres to be setup in remote locations where conventional classes would be prohibitively expensive.
- Rich creative content can be developed that provides opportunities to explain learning points in interesting, absorbing and imaginative ways.
- The pace of the material can be adjusted by the learner. For example, learning points and topics can be repeated as often as required.
- Smart adaptive learning programs can also automatically personalise the overall learning experience to the style best suited to the individual learner.
- Links embedded in e-learning content can seamlessly provide access to a wealth of additional support and reference materials. For example, links to further e-Learning content, access to online libraries, educational establishments and the millions of useful public web sites.
- Central control of e-Learning material, with delivery on demand, allows the material to be kept up-to-date and errors to be corrected immediately. There is the added benefit of reduced administration overhead and the reduced cost of purchasing hardcopy material.

E-Learning is evolving as improved communication allows it to encompass live and recorded broadcasts, online interactive classrooms, interactive group discussions and tutor/student sessions.

# Building Partnerships and Relationships

Governments will increasingly need to collaborate with the commercial sector to achieve their goals.

## Partnering with Commercial Organisations

The technologies and processes for developing e-Learning systems are already widely used in the private sector.

It is therefore advantageous for governments to tap into this expertise and work with commercial companies, or better still, collaborate through public private partnerships with organisations that can provide both the required expertise and share the risk and rewards.

### Success Stories:

An example is the Portuguese Government's e-U (Electronic University) initiative to drive the use of technology in education. To encourage the deployment and use of wireless LANs throughout campuses, it has partnered with a bank and hardware provider to give all students the ability to purchase top brand portable PCs with wireless LAN capability at preferential prices and arranged through a loan if required.

The design of a consistent and complete e-Learning solution – infrastructure, content and delivery – that is commercially viable for a country's core educational curriculum is a major undertaking. It is essential for governments and educational establishments to maximise the effectiveness of their investment in any new e-Learning solutions and ensure they are designed to support standards and to be extensible and upgradeable so that the new solutions do not themselves become future legacy systems.

Intel's extensive experience in education, as described below, can benefit the design and delivery of next-generation E-education solutions. Intel is helping governments such as the United States, the UK, Mexico, Spain, Portugal, Sweden, Dubai, Russia, China and elsewhere round the world to maximise the returns on investment in technology. This includes projects that share best practice and drive communications and computing industry initiatives that support ICT education, PC adoption programs and e-Government delivery.

## Intel IT Innovations Centre

Intel's IT Innovation Centre has global responsibility to research and develop leading-edge ICT solutions and technology.

It is at the forefront of demonstrating how Information Technology and Intel products can continue to deliver new competitive advantage through the development of compelling new value propositions. A key driver is the identification and resolution of real business issues through developing leading edge ICT solutions. Focus areas include solutions for mobile workers, and the development of education and e-Learning technologies.

The Innovations Centre collaborates with leading universities to research and develop the technologies and solutions to deliver on the e-Learning promise. These include:

- Adaptive e-Learning: Trinity College Dublin, University of Graz
- The Future of Learning: MIT Media Lab
- Pan-European collaborative e-Learning environment: Reading University

Adaptive learning is a leading edge development in e-Learning. The emergence of a new generation of adaptive e-Learning systems permits a tailoring of content to the specific needs and capabilities of the learner. These next generation adaptive e-Learning solutions will increasingly deliver much more than pre-packaged learning content; the learner will receive a learning experience customised specifically just for him or her. These solutions will be based on new service-oriented solution architectures. Intel has the high performance solutions for the servers and clients required to enable adaptive learning.

The IT Innovation Centre is also responsible for many other e-Learning projects. Including:

- The multi-award winning online education resource [www.skool.ie](http://www.skool.ie) for Irish school students which is now also being rolled out in Sweden.
- The Managed Learning Solution project used in Oklahoma schools (discussed later).
- Intel in Education. This has helped over 650,000 teachers in 26 countries apply computer technology effectively in the classroom to improve the experiences of 50 million students. In 2003 this is expected to reach one million teachers across 28 countries.



# Government E-Learning Curriculum

High quality e-Learning and support materials developed for standard curriculum areas will provide a consistent and enhanced learning environment for students and teachers.

## Benefits and Opportunities

Governments are responsible for defining national/regional core curriculum, but not the actual content presented to the student.

Today this content is provided primarily through conventional teacher led classroom sessions and supporting textbooks. The emergence of e-Learning is not only changing the way students learn, and automating certain aspects of the learning process; it is also transforming the way teachers work.

Many governments see the next logical step as the creation and coordination of a set of e-Learning modules that cover the core national/regional curriculum. However such a structure would also need to be flexible enough to allow curriculum responsibility to be delegated down to the school or even the teacher. The key technologies exist to support this curriculum goal:

- Tools to create quality e-Learning material (and e-Learning providers to supply the material)
- The Internet and communication technologies, including broadband, satellite and wireless networks to deliver the e-Learning content
- Intelligent software to cater for different learning styles
- Powerful PCs and portables to present the e-Learning content

This material could be made widely available through government educational establishments. It could also be licensed to commercial education and training organisations. The result would be to achieve a high level of educational consistency across a country/region.

The core school curriculum could be targeted first, followed by some areas of higher education and university courses. The content could be developed for use in an e-Learning only, a classroom, or a combined 'blended learning' environment. This would allow the material to be used in any of these forms by conventional educational establishments, as well as in a primarily remote e-Learning mode for adult education.

Since the core curriculum would be used by many schools it would justify the substantial investment necessary to enable it to be developed to a very high quality. Corrections and updates would be centrally managed. In addition to the learning material that the student receives, there would be a comprehensive set of aids to help a teacher prepare for the course and to best deliver the topics and learning points. This approach would not diminish the role of the teacher or mean their individuality is lost; instead it would be a framework within which they can provide a richer educational experience.

### **E-Exams**

With tight control over the learning material, examinations would benefit from being controlled centrally, too.

For some subjects such as maths, science and engineering, multiple-choice format exam questions entered directly into a computer, or scanned in, could be marked automatically and a pass or fail assigned immediately. Since not all subjects lend themselves to multiple-choice format questions, a team of examiners would still be required. They could use their 'examiner portal' to mark exams wherever they were located. This would help speed up the marking of exam papers.

Automated tools could also help examiners, for example, to check course essays or assignments had not been copied off the Internet or from a fellow student. Such a semi-automated and remote marking system would also allow mature students to sit exams at any time by registering and attending a public examination centre.

### **On-line Testing Today**

A similar examination testing approach is used very successfully today for some professional qualifications, particularly in ICT.

For example, Cisco Systems (networking), Hewlett-Packard (hardware) and Microsoft (software) have created extensive courseware, which they sell to training organisations who then offer public training courses. These companies are also looking at offering e-Learning options. Students can take the electronic multiple-choice tests at one of a number of test centres around a country. The student is informed immediately as to whether they have passed or not.



# E-Learning in Schools and Higher Education

## E-Learning Infrastructure

A connected infrastructure is a requirement for remote e-Learning. However for online e-Learning, where rich content is downloaded a high-speed link is important and in some cases essential.

The availability and cost of high-speed broadband connections varies widely between countries, and coverage tends to be very patchy in rural areas. In addition in some countries high-speed wireless LANs are also beginning to appear in some cities and local communities. Overall the important challenge to increase the availability of inexpensive high-speed connections is being addressed – hastened in many cases by government initiatives.

Where land-based connections are not available some governments are using satellite links or Wi-Fi to overcome this barrier in the short term, as is the case with the Nuevo Leon's Community Learning Centres.

Governments and education establishments are using Intel technology – powerful servers, desktop PCs, wireless portable PCs and Personal Digital Assistants (PDAs) because they are non-proprietary, are available from many vendors, support a broad range of off-the-shelf applications, and offer lower cost of ownership.

### Success Stories:

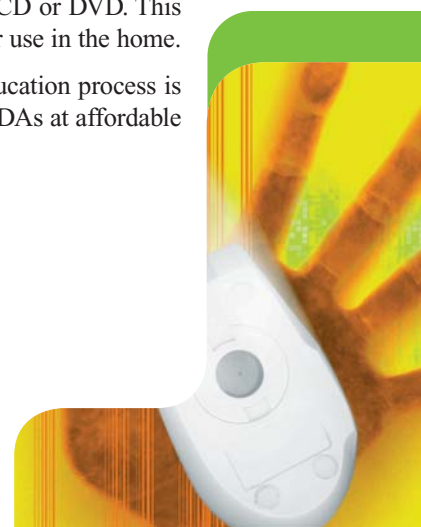
In Mexico to help sustain its economic momentum, Nuevo Leon's Division of Labor and Human Development has established Community Learning Centers to raise literacy standards and skill levels so that more of its citizens can compete for higher-paying jobs. For this population, dispersed throughout the 25,000 square mile state, remote e-Learning has been essential. Over one hundred Community Learning Centers will be in operation in Nuevo Leon this year in practically every community of the state. Using Intel® Pentium® 4 processor-based PCs, the Community Learning Centers are able to deliver locally stored sophisticated e-Learning content and provide Internet access, while at the same time allowing citizens to become proficient with the standards-based technologies they will encounter in the workplace. Content is downloaded to the PCs overnight through the wired or satellite Internet connection.

Without a high-speed connection (and a client with the power to process the sophisticated content) e-Learning modules need to be designed with less rich content. The site [www.skool.ie](http://www.skool.ie), developed by Performance Learning Solutions (PLS), an Intel division that provides leading edge e-Learning and knowledge transfer products and services, is a good example of what can be achieved – even in areas where a high-speed connection is not yet available or economically feasible.

Intel has also developed innovative peer-to-peer rich media e-Learning content distribution technologies that enable a PC requesting content to retrieve it transparently from other local LAN-based PCs rather than from a remote server across a slow WAN connection. This delivers the content much faster. In some situations, where network connection time is charged by the second or by the amount of data transferred, this technology can also reduce costs by minimising the use of the network. Intel has applied this technology to enable users of the skool site to securely and efficiently download rich media learning material to have a rich learning experience.

However, e-Learning does not have to be online. E-Learning content can be run from a CD or DVD. This would still allow, for example, a student to bring home an e-Learning CD from school for use in the home.

A further basic requirement to enable e-Learning to become an integrated part of the education process is the availability of suitable high performance rich clients, including PCs, notebooks and PDAs at affordable prices.



## How PCs are Used in School Today

Most schools today have one or more classrooms with computers connected to the Internet.

With this equipment students are taught about computers and essential PC literacy; how to use PCs and key applications, including using the Internet. However, in general, it does not extend to using these computers as an education tool with e-Learning material to learn school curriculum subjects such as geography, history, science and so on. There are a number of reasons for this including:

- The cost of additional PCs and the ICT infrastructure required in schools
- Limited awareness of the potential benefits of e-learning
- Emergence of quality e-learning material aligned to the national (or regional) curriculum

## E-Learning in the Future

With the widespread use of national e-Learning curriculum in schools the ratio of PCs to students will need to rise dramatically.

However, in order to realise the full potential of e-Learning, students each need their own portable PC that they could use both at school and home – just like higher education students. Schools will install wireless LANs allowing students to easily connect to school community resources, including e-Learning material, digital libraries and other school communities and campuses.

The Intel® Centrino™ mobile technology-based notebooks with handwriting capability are ideal for students. In addition those with learning challenges such as partially sighted would also benefit significantly from the latest software and Intel tablet PCs to help them learn more easily.

The student's portable PC would be integrated into every aspect of the student's school day. Every lesson, such as a geography or science lesson that forms part of the curriculum would be available in electronic (e-Learning) format for the student to use. This material would be accessed through the school's intranet, or possibly stored locally on their portable PC. The teacher's live delivery of a lesson would essentially use the same e-learning material and be presented to the class using a video projection system. In this blended learning environment students would be encouraged to use the e-learning material working alone and in groups. The teacher would provide additional information to help the students understand the material. The delivery, associated explanations, examples and exercises, would all be an essential part of the learning experience.

Students would also use standard "office" tools in their day-to-day activities to write up assignments, for email and calendaring, filling in administrative forms and to access the Intranet/Internet. This would have the added advantage of allowing students to become acquainted with the digital environment they will ultimately meet in the workplace.

There are many advantages to this blended learning approach. For example, if students are ill or unable to attend an instructor-led lesson, then they would have an e-Learning option that they could use to continue their studies. It allows students to learn at their own pace; material can be covered a second or third time to consolidate the learning points – an advantage for slower learners. The e-Learning version would contain additional material and references to enable students to delve deeper into a topic, if they wished. Students could have the option to read ahead or even look at lessons and topics that are not part of their core curriculum. Multiple-choice tests would be incorporated continually to assess the student's learning progress. Since students can undertake much of the learning without the direct involvement of the teacher this allows the teacher to focus on the best way for students to learn and to reinforce key or difficult topics as a group. It also means the teacher can spend more time on the weaker students.

## Wireless Campus Comes of Age

Some higher education institutions and universities have already installed campus wireless LANs (Wi-Fi). Line-of-sight aerials have been used to cost effectively extend the wireless LAN to remote buildings up to a mile away.

Students living in off-campus accommodation will be provided with a wireless LAN connection link to the campus through the Internet. All of this means students, no matter where they are in the virtual campus, will have seamless access to resources and services.

Like any workplace, wireless LANs benefits staff as well as the highly mobile teachers and students. Students will be able to use wireless PDAs, such as Intel® XScale™ technology, as well as portable PCs. However wireless LAN notebook and tablet PCs have proved to be the most versatile education tool, since in addition to being mobile, they offer a full function user interface, the power to run a wealth of standard applications and extensive local storage. Newer portable PCs also now have a longer battery life that can be attractive to students on the move.

### Success Stories:

An early adopter of a wireless campus is in the United Arab Emirates, which uses Intel-based technology to improve its educational process. Dubai Women's College in the United Arab Emirates is using Intel Pentium 4 Processor-M notebook computers with wireless networks. As a result, students and faculty are able to access information from anywhere on campus. This has led to new teaching methods, better collaboration, and increased productivity and students who graduate with a better education and valuable computing skills. In addition, the college ICT staff has been able to reduce support costs and avoid the deployment of expensive computer labs. Examples of how teaching methods have changed is that lectures are on the wane, classes are online, pencil-and-paper tests are becoming a thing of the past, and even the way students learn new skills is evolving, as illustrated by the way the college has moved part of its curriculum to project-based work. Students now spend four or five weeks on a project that integrates several subjects that used to be taught separately. In this way they learn to combine their skills. Moving forward the college is looking to implement videoconferencing and multimedia e-learning into its curriculum.

### Success Stories:

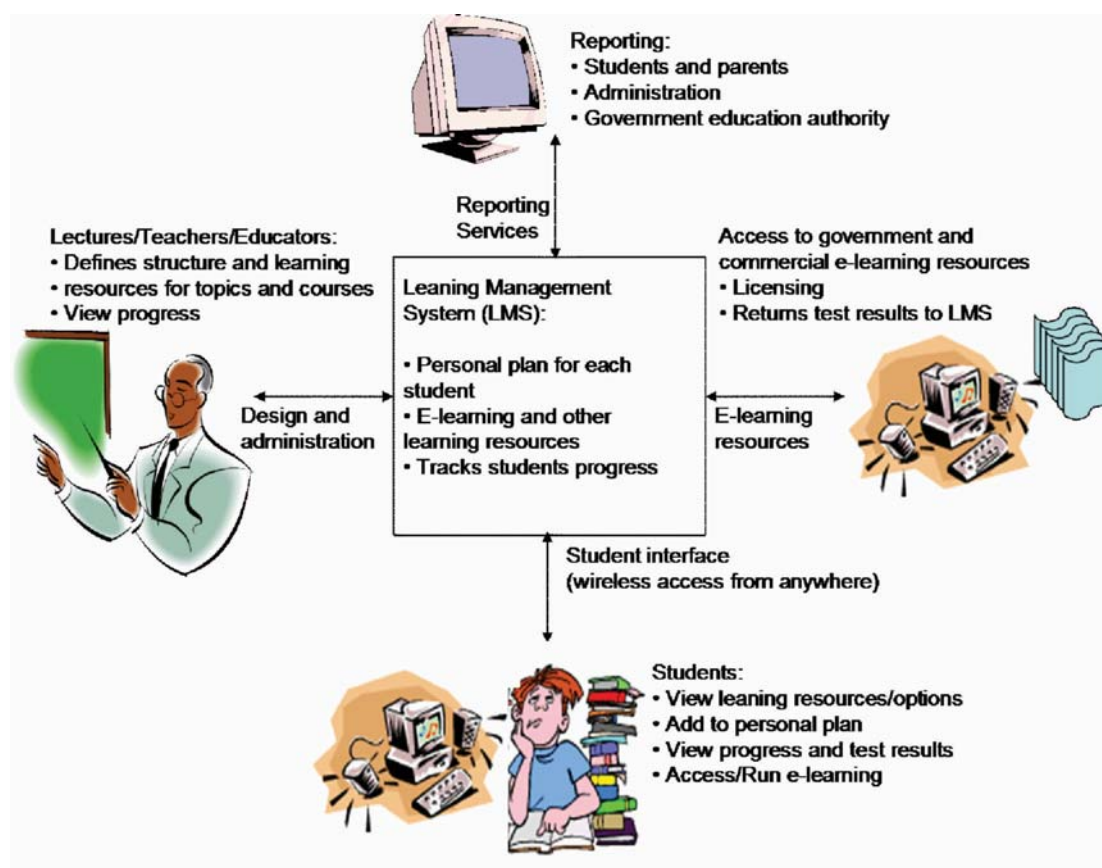
A second example is the Portuguese Government e-U project ([www.e-u.pt](http://www.e-u.pt)) virtual campus. The virtual campus is designed for the creation of university services online, the production and sharing of academic content and the setting up of university communities. Students have access to classes, e-Learning, research and development articles, student papers, grades, bookshops and academic administrative services online, as well as access to the internet through a broadband wireless LAN. The e-U project is being adopted by universities all over the country and beyond. The "Universidade Lusíada" has three Universities in Portugal and three more Universities in the Popular Republic of Angola with a total of about 16,000 students attending courses of undergraduate, postgraduate, Master Degrees and Doctor (PhD) studies, and about 1,500 teachers. The introduction of a virtual campus was seen as a way of better utilising student and instructor time, improving the education process and experience, and lastly as a way of attracting additional students to the university.



## Learning Management Systems

A Learning Management System (LMS) allows the teacher's time to be used more efficiently by automating routine functions and automatically monitoring student progress.

This is important given the expected increase in student numbers, in higher education and university. For students it offers a controlled learning framework but with a more flexible learning environment and options.



## Managing the Learning Process

A learning management system (LMS) allows a teacher or department to create a defined learning path that specifies the learning elements, or resources, students must cover and then monitors their progress through these elements and assesses their performance.

These elements could include lessons/lectures to attend, e-Learning modules to take, books to read, assignments and assessment tests to complete. The LMS logs the student's progress and results of assessments.

Self-paced multimedia e-Learning will be an increasingly important option. This could be core government e-Learning material, other commercial e-Learning material or content developed by education institutions themselves.

E-Learning material can be a very effective way to learn, provided it is well designed. The way the learning objects are presented in terms of their ordering, the use of graphics/animation and audio, the level of user interaction and testing, and links to additional support materials are all important and contribute towards an engaging, rewarding and even an entertaining experience. In short, designing quality material that keeps the learner's attention and motivates them is challenging. Conformance to standards should enable e-Learning material to be used with any LMS allowing, for example, test results to be integrated back into the specific LMS.

The student's interface through their portable PC to the LMS allows them to see their progress and test results. They can select particular resources; run e-Learning modules, read e-books, watch and participate in online lectures, join online discussion groups, and through a Web cam, use video conferencing for group and one-to-one tutorials. This integrated yet managed learning approach offers the student a structure within which there are a number of ways to learn, with the potential for a reduced focus on physical lectures.

## A LMS Example

Intel worked with solutions providers Dell™ and Microsoft® to develop a Managed Learning System (MLS) solution. The MLS specification, on which the solution is built, is a standards-based framework that allows all elements of an educational ICT system to communicate and interoperate.

The core of the MLS solution is Intel-architecture Dell servers, Microsoft Class Server and the Academic Standard and Assessment System (ASAS) from JES & Co. (an educator-based non-profit organisation). The MLS components include educational content and delivery, academic standards, assessment and testing, technology and business processes.

The ASAS provides an easy way to:

- Search for state and national standards
- Search for and retrieve assessment items and resources aligned to state and national standards
- Locate classroom materials according to content areas, useful keywords, topics and/or categories

A key driver for the adoption of the MLS in the United States is the requirement for schools to address the four pillars of the Federal Elementary and Secondary Education Act – commonly referred to as No Child Left Behind – alignment, assessment, access, and accountability. The Act places new demands on teachers and administrators to raise student achievement, and document, in considerable detail, ongoing improvement and success.

**Success Stories:**

In Oklahoma, Intel, Dell and Microsoft, worked with political and educational leaders at the state level to fund the Virtual Internet School in Oklahoma Network (VISION) project, a program that focuses on realising technology’s potential for improving communication, instruction, and accountability among teachers and students, teachers and parents, school and districts, and districts and state agencies. The VISION project goal is to develop and deliver Web-based, standards-aligned curriculum to all 500 Oklahoma school districts, serving more than 600,000 students.

Since 2001, nine Oklahoma school districts have demonstrated the potential of Web-based instruction as the “early adopters” of the Oklahoma VISION project. Oklahoma developed convincing evidence that integrating technology into the classroom can positively impact student achievement. Oklahoma is working to expand their standards-based curriculum management solution to include additional educational materials, including a unique resource exchange program with counterparts in Australia



# The Way Forward

Governments worldwide are embracing e-Learning technologies based on scalable, cost effective Intel-architecture hardware, open standards and the Internet to meet their commitment to improving educational services to all factions of society and to use teaching resources more efficiently.

The resultant digitally literate, highly skilled, workforce is a major economic benefit.

Key issues include:

- High quality e-Learning content aligned to the national curriculum designed to be used in a pure e-Learning or a blended learning mode.
- School students, like students in higher education, must have their own personal portable PC that can be used in all lessons and also at home for remote learning.
- Notebooks and tablet PCs based on standard Intel Centrino mobile technology with wireless LAN support built-in will hasten the adoption of Wireless LAN virtual campuses and digital schools.
- Learning management systems will increasingly be used by education establishments to effectively control, monitor and report the progress of learning programmes created for students. Adaptive e-Learning techniques will further improve the effectiveness of e-Learning to the individual.

Intel's in-depth knowledge of e-Learning technology solutions and research through the IT Innovations Centre have allowed Intel to assist governments to select the right technologies and partnerships with commercial companies to ensure successful, future proof e-Learning implementations.

To find out more about how Intel can help you or to learn more about Intel's IT Innovations Centre and e-Learning initiatives contact your local representative. Also see the Intel web site at <http://www.intel.com/education>.







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