For the past three years, and in response to the request of Education Ministers in OECD, CERI has launched a major study on the importance of ICT in education. The focus has been on ICT’s impact on educational innovation and reform, student learning and experiences, the role of the teacher, ICT partnerships and market developments and, not least, the issue of access to ICT for all. The research will be completed early in 2002. This brochure summarises results so far, under five main themes, in each case describing the present situation, emerging issues, and possible ways ahead. The five themes are: towards a changed educational culture; e-learning and partnerships; learning to bridge the digital divide; teaching and learning; and research and development.

“People, education and learning lie at the heart of these issues and their solutions. The machines and sophisticated ICT equipment are useless without the competence to exploit them... the gaps that define the ‘learning digital divide’ become as important as the more obvious gaps in access to the technology itself.”

Donald J. Johnston, OECD Secretary-General
Governments, the private sector, families and individuals have made and are continuing to make huge investments in ICT for education and learning. In its 1999 Education Policy Analysis, OECD estimated an annual and growing figure of US$ 16 billion for OECD countries across primary, secondary and tertiary education, within which the bulk was spent on hardware and networking, little on software and only around 5% on teacher training. One consequence of the investment is a dramatic growth within the whole education system in the use of computers with access to the Internet for e-mail, and for teaching and learning purposes.

Figure 1 indicates the percentage of school students with such access across 13 OECD countries. While there is considerable variation, almost all lower secondary schools in Finland, Canada and Iceland have access.

Towards a Changed Educational Culture

Present situation

During the year 2000, 95% of Australian children aged 5-14 had used a computer, and half of these had accessed the Internet. In Sweden and Canada, around three-quarters of youths aged 12-24 access the Web from schools, and more than 90% of students in those countries with Internet access use the Web to complete school assignments. These are not isolated developments. At the level of Higher Education, institutions are investing heavily in the development of on-line learning materials, whether to enhance traditional faculty teaching or for separate distance-learning purposes, as Figure 2, covering the U.S., indicates:

<table>
<thead>
<tr>
<th></th>
<th>1998</th>
<th>2002</th>
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<tbody>
<tr>
<td>Four-year colleges offering distance learning</td>
<td>62%</td>
<td>84%</td>
</tr>
<tr>
<td>Student enrolment in distributed learning</td>
<td>710,000</td>
<td>2,200,000</td>
</tr>
</tbody>
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Critical Issues

Many sectors have undergone wholesale transformation under the influence of ICT - automobile, textile, retailing, banking - to deliver huge gains, though often with considerable tensions during the period of implementation. However, more than any other sector, education - with its focus on students and teachers - is labour-intensive. Its mission is often seen in part in terms of safeguarding and transmitting a particular knowledge culture, with a predominance of face-to-face teaching. The adoption of ICT poses a vast challenge to conventional practice. Furthermore, such traditional views of teaching are coupled with a rapidly ageing teaching force in most OECD countries, making the in-service training of teachers for the use of ICT a very complicated task. On the other hand, most new teachers will have had good ICT training during their pre-service period. A force of innovation, although often untapped, exists in terms of the students’ knowledge and willingness to work with ICT in learning. Promising examples exist of ICT-knowledgeable students becoming ‘teaching assistants’, to help other students who are less familiar with ICT.

The Way Ahead

The comprehensive changes in education and learning brought about or made possible by the adoption of ICT require a fundamental re-appraisal of the learning environment and support systems, whereby the underlying aims of education can be strengthened and adapted to the changed circumstances of a massive penetration of ICT-based education and learning. Such an appraisal will have to include at least the following:

- **ICT INFRASTRUCTURE.** Most countries are today involved in a phase of building up the needed hardware and connectivity. It is a fundamental objective to ensure that all learners and teachers are adequately equipped, and that equipment is maintained.
- **PEOPLE.** The challenge is to convince all - school leaders, teachers, and students - to use ICT in their daily work and profit from doing so. This is where training and retraining will be needed on a major scale, with appropriate incentives, so that educational institutions become learning organisations.
- **PARTNERSHIPS.** There is a compelling need to develop and strengthen partnerships: **horizontally** between education, the private sector and the community at large, to build and maintain an adequate ICT infrastructure; and **vertically** between the different sectors of the education system, notably higher and secondary education, in respect of subject matter and pedagogy.
- **EVALUATION.** Research and evaluation are needed to show ‘what works’ and ‘what does not work’ in the implementation of ICT, particularly for the in-service education and training referred to for school leaders and teachers.
Private venture-capital companies are anticipating that e-learning will develop rapidly and that e-learning markets will grow substantially over the coming years, across school, post-secondary and the corporate sector, whether in the U.S. (as in Figure 3 below), or elsewhere in OECD countries and the global market:

| e-learning market in U.S. ($ billion, estimated) |
|-----------------|-----------------|
| School          | 1.3             | 6.9             |
| Post-secondary  | 1.2             | 7.0             |
| Corporate       | 1.1             | 11.4            |


These estimates of e-learning markets in 2003 are impressive. Already, e-learning has been integrated into traditional university courses, the use of the Internet being an integral element in 39% of all college courses in the U.S. in 1999. Nevertheless, a lot of uncertainty exists in terms of technology and content provision. The e-learning markets themselves are volatile and unpredictable, as is illustrated by the many closures and buy-up mergers among private companies.

The emergence of partnerships has become crucial for the development of e-learning. The sheer cost, scale and content complexity of e-learning make collaborative activity all but inevitable, particularly if countries are to make progress in lifelong learning. People and organizations need to reach outside their own core competencies and skill-sets, if they are to deliver the products and services required in an increasingly global economy. Schools, universities, libraries, publishers and broadcasters are collaborating with telecommunication and software companies, to take advantage of the potential for new business opportunities in the education market.

The fastest developments are seen in post-secondary and corporate education. The number of cross-border public-private alliances in post-secondary education is rising rapidly, to match growing competition in an increasingly global e-learning market. In the school market, partnerships are often national and concentrate on high-quality software development. There is also an emerging issue for the school sector relating to the costs of different computer operating systems, for instance Linux, for which the codes are open and are distributed free, and the dominant closed systems.

Critical issues

Governments must have a clear understanding and purpose in regard to the following:

- There is so far no internationally accepted quality assurance framework for post-secondary education. However, students will increasingly be offered a range of post-secondary courses, often from unfamiliar providers operating outside their country's jurisdiction.