

**OECD STUDY ON DIGITAL LEARNING RESOURCES
AS SYSTEMIC INNOVATION**

COUNTRY CASE STUDY REPORT ON ICELAND

Final version

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1. INTRODUCTION

This is one in a series of country reports prepared as part of the study on Digital Learning Resources as Systemic Innovation being conducted by CERI/OECD during 2008. It focuses on six case studies of systemic innovation in the Icelandic school system and draws on:

- background information provided by Icelandic officials on six case studies and
- meetings and interviews conducted during a study visit to Iceland that took place on 1st -3rd September 2008.

The visiting team consisted of Roger Blamire, Senior Manager at the European Schoolnet; Magnus Boman, Professor in Intelligent Software Services at the Royal Institute of Technology, Stockholm and Research Lab Leader at SICS, Kista; Mike Trucano, Senior ICT and Education Specialist from the World Bank¹; Francesc Pedro, Senior Analyst at the OECD/CERI Secretariat; and Jan Hylén, consultant to the OECD/CERI Secretariat. During the visit the team met with a range of stakeholders involved in the case studies pre-selected by the national coordinator for detailed study in the context of the project. Participants' details are in Annex 1.

The overall aim of the study is to review and evaluate the process of innovation involved in policies and public as well as private initiatives designed to promote the development, distribution and use of digital learning resources for the school sector. In so doing, the activity will bring together evidence of:

- how countries go about initiating ICT-based educational innovations related to digital learning resources, the players and processes involved, the knowledge base which is drawn on, and the procedures and criteria for assessing progress and outcomes;
- what factors influence the success of policies aimed at promoting ICT-based educational innovations, particularly those related to the production, distribution and use of digital learning resources including user involvement in the production process and new actors such as the gaming industry and media companies;
- user-driven innovations related to digital learning resources, carried out by learners and teachers, such as innovative production and use of digital learning resources, and how the educational system responds to such innovations.

Accordingly, instead of focusing on discrete institutional innovations, this activity aims at a better understanding of how the process of systemic innovation works best in relation to digital learning resources, and which factors, including governance and financing, influence its development.

The definition of systemic innovation adopted here is: *any kind of dynamic, system-wide change that is intended to add value to the educational processes and outcomes*. The aim is to analyse innovation systems and strategies regarding the production, distribution and use of DLR by bringing together evidence of the drivers for systemic innovation in the five Nordic countries: Denmark, Finland, Iceland, Norway, and Sweden. All countries participating in the study have selected at least three case studies of recent DLR innovations for in-depth analysis by the expert team.

¹ The findings, interpretations and conclusions expressed herein are entirely those of the author(s) and do not necessarily reflect the views of the International Bank for Reconstruction and Development/The World Bank and its affiliated organizations, the Board of Executive Directors of the World Bank or the governments they represent. The World Bank cannot guarantee the accuracy of the data included in this work.

This introductory section provides a brief overview of information and communication technologies (ICT) in the Icelandic educational system followed by a short description of the different case studies selected for the study. As these form the main focus of this report they are described and discussed in more depth in later sections of the report. The cases were selected by Icelandic officials, in collaboration with the OECD/CERI Secretariat. Unless otherwise noted, specific figures and data cited here are drawn from the National Background Report: Iceland (Macdonald, 2008).

1.1 Context

Iceland is a small nation with a population of around 310.000 people. About two-thirds of the population lives in the Greater Reykjavík area in the south-west of the country. Iceland entered the information society and brought in and developed ICT with enthusiasm. It is a highly technological society with an active private sector. Over 400 enterprises were operating in the IT sector in 2005, employing over 6000 people. In 2008 more than 90% of the population is estimated to use computers and the Internet, with slightly higher figures in urban areas.

There has been government coordination of IT and the information society since the mid-1990s. In 1996 the Office of the Prime Minister published its first policy document on the information society. Both the public and the private sector have been and still are willing players in the information age. In the mid-1990s the Ministry of Education, Science and Culture also published the first of its policy documents on the information society and an IT development division was established in the Ministry of Education in 1999/2000. A new national curriculum for pre-schools, compulsory and secondary schools was issued by the Ministry in 1999, in which using IT was to be seen as a cross-curricular opportunity as well as a skill in itself.

The late 1990s were a time of major changes in education in Iceland. There were several major reforms in schools in the 1990s, with new laws on preschools in 1994, on compulsory schools in 1995 and of secondary schools in 1996. New administrative arrangements had to be made. Additional resources were needed, both human and financial, and operational mechanisms had to be put in place to respond to these challenges and new opportunities. At the same time changes in technology in the workplace and changes in society in general were becoming even more diverse and demanding and it was perhaps inevitable that information technology made its way into schools.

1.2 ICT in education

ICT entered the education system in Iceland in the 1980s and very quickly a variety of computers and educational resources became available, notably educational software and content for use on Apple and BBC computers. In 1988 a communications network called Imba 1, was developed, to which schools started connecting in 1990. By 1992 most compulsory schools in the country had joined the network (Ísmennt, n.d.).

Early digital learning resources (DLR) were written by computer programmers with an interest in education or in association with educators. Icelandic teachers and student teachers were introduced to mathematics programs and a physics educator started introducing students and teachers to programs for use on Apple computers. The promise of ICT for areas such as language and mathematics learning, especially through drill and practice, seemed untold.

At the same time, ICT was becoming common in the workplace and soon word processing, spreadsheet and database applications were making their way into schools. Two separate committees considered the use of computers in schools in the 1980s and the post of subject adviser on the educational use of computers was created in 1986. The 1989 national curriculum for compulsory schools included a section on using computers in schools. With the rapid spread of the World Wide Web in the 1990s, both teachers

and learners began to use or even design their own web-sites. The development of a myriad of possibilities for working with visual images opened the way for a mix of text and images. DLR were beginning to take shape.

ICT entered schools at the same time as IT was becoming commonplace in society and in economic activities. The 1999 national curriculum gave ICT much more visibility than the curriculum of 1989 and encouraged the development of skills and cross-curricular use.

The use of ICT in schools is supported by local authorities through investment in resources and training. According to MacDonald 2008, research in Iceland indicates that teaching practices and the traditional way in which schools are organised through classrooms and timetables constrains innovative approaches to the use of ICT and DLR though creative use is found among individual subject teachers.

The first ICT policy document in education, *The power of information* from 1996, laid out activities and aims in efforts to bring ICT and the use of DLR into schools. Much emphasis was placed on the development of software, with the National Centre for Educational Materials (NCEM) to have a key role, though others would also begin to produce materials. Teacher education would help train teachers in the use of ICT and support would be provided for school leaders to keep abreast of developments. Guidance would arise from the experiences of schools in the ‘nuclear schools’ project. Schools would facilitate the use of ICT through timetabled ICT lessons, the deployment hardware, and research on the effect and use of ICT would be carried out.

Since then a number of policy document have been issued, both from the Prime Minister and the Ministry of Education (see Figure 1). The key issues and activities in the respective policy can be found in the national Background Report (Macdonald, 2008)

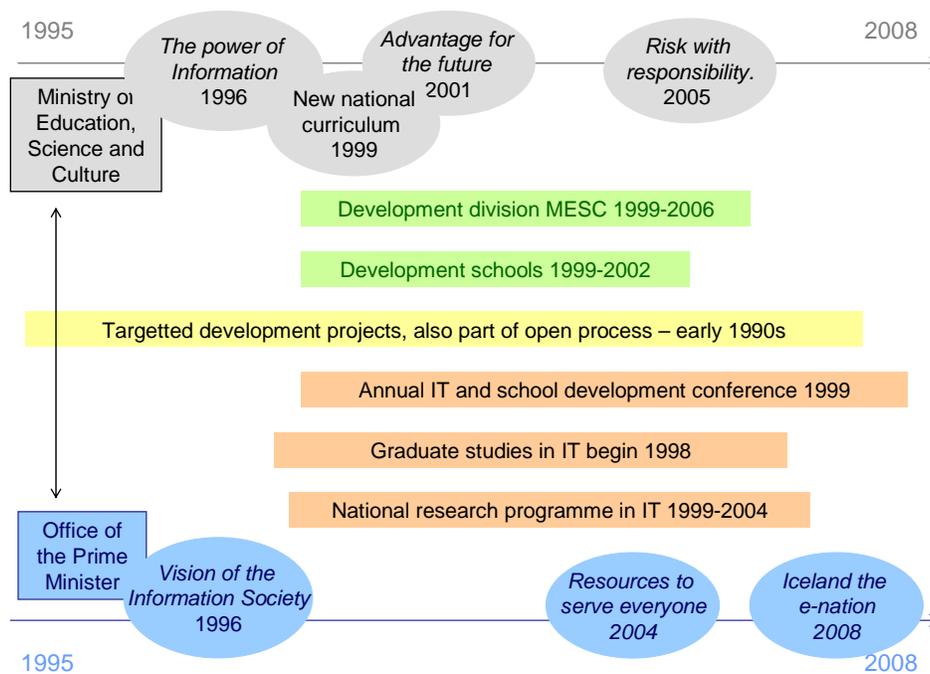


Figure 1 Key policy documents and formal activities regarding ICT (from Macdonald, 2008)

No figures were available to the OECD study team detailing related investment in infrastructure, but, generally this is an onerous cost for local authorities. Likewise, most local authorities have supported continuous professional development in ICT and teacher education courses for those aiming to specialise in ICT and return to their schools after graduate studies.

2. THE CASE STUDIES

It was agreed between the OECD Secretariat and the Icelandic working group for the OECD/CERI project on systemic innovation and digital learning resources that, in a country as small as Iceland and in the light of policy developments since the mid-1990s, an analysis of two collective case studies, or sets of studies, could provide a more valid reflection of innovation involving digital learning resources than two or three single case studies. The cases selected should give a sense of the changes which have taken place since 2000 with regard to DLR as innovation.

Two particular developments are addressed in the studies selected:

- the general provision of digital materials aligned with the compulsory school curriculum and
- the development of language materials both for immigrants and for the mobile Icelandic population.

The case studies should provide a sense of the smallness of Iceland and the vulnerability of small systems to systemic change, where the actions and views of individuals can have a noticeable effect in promoting or constraining change. They should also reflect changes in society over the last 10-20 years. The language and culture of this small nation are considered by its inhabitants to be of value and worth preserving, but the stories told in the language cases should reflect the top-down political approach relying on a bottom-up professional response.

The opportunities and risks arising from the interplay between the deliberations behind national policy and the activities of pioneers in setting up viable educational websites and portals to meet the demands in the field is worth exploring more closely.

2.1 Collective case study A: DLR and the curriculum

Collective case study A considers access to and the development of digital materials linked to the curriculum. It addresses the response of authorities and the school system to new educational policy, i.e. to the national curriculum, from 1999 (NC1999) which was a major revision of the 1989 national curriculum. The 1999 curriculum was in turn revised in 2007 with the new revisions being mandatory for schools from 2010. The NC1999 came in the wake of a new law on the compulsory school system which was passed in 1995, with decentralisation to local authorities coming into effect in 1996. Many questions arose with the NC1999. What was the role of individual teachers – would they have less or more responsibility? Would more options be available to learners, as promised in the policies? How could the intended changes be realised within the Icelandic system?

2.2 Collective case study B: DLR and language issues

Case study B addresses the educational implications of changes in society, in particular, the rising numbers of Icelandic students who have lived abroad and the emergence of Icelandic as a second language.

Many projects are school-based and limited in time, but the examples taken here have been considered accessible country-wide from the outset. The first five cases reach children in Icelandic schools and the sixth reaches Icelandic children abroad. Staffing of all the projects is low, except perhaps in the case of the School Web.

The Icelandic cases are listed in Table 1.

Table 1 **Overview of Icelandic DLR cases**

		Direct funding	Project funding	National curriculum links	Language developments	Research base	Staff/size
CASE A System-wide curriculum-related innovations							
A.1.	Ed. Gateway	x		x		(x)	1 person
A.2.	NCEM	x	(x)	x			1 editor +
A.3.	School Web		x	x			8-10 staff
CASE B Innovations in digital resources for language learning							
B.4.	Language Studio		x		x	x	2-3 staff
B.5.	Katla Web		x		x	x	2 part-time
B.6.	IceKids		x		x		2 part-time

3. CASE A 1: THE EDUCATIONAL GATEWAY

The Educational Gateway (<http://www.menntagatt.is>) is Iceland's national education portal. It serves a number of functions, including indexing, highlighting, summarizing and (as possible) linking to on-line learning materials. It seeks to help teachers, learners and parents identify educational content, especially content available on the Internet, relevant to specific parts of the national curriculum, grouped by grade level and subject. It is also a clearinghouse for news, school-related information, information on education projects and initiatives, and hosts on-line discussions.

The Gateway provides an excellent case study of how a national-level Internet-based innovation can be successfully introduced and implemented into an education system while at the same time highlighting the challenges in both sustaining such an innovation over time *and* providing mechanisms for further innovation.

3.1 Implementing the innovation

The concept for the Gateway was first bruited in the late 1990s, and formal planning began in earnest in 2000. Until then Ísmennt, which was established in the early 1990s and bought by a private company in the late 1990s, had served some of the functions of a national portal. While the concept for an educational portal of this sort was not considered particularly new or innovative within the community of OECD countries at this time, it was the first site of its kind in Iceland when it was introduced in 2003. Similar sites in other Nordic countries and the Netherlands served as rough models for the project initiators but unlike the Gateway did not map and provide links between the digital materials and parts of the national curriculum. The New Zealand portal was similar in concept to the Gateway.

The Gateway soon became an important tool to help teachers, students and their parents better navigate and make sense of the vast amount of resources available on the Internet in ways useful and relevant to teaching, learning and administrative activities in Iceland's compulsory schools. In a manner perhaps not uncommon to many new education initiatives in Iceland (and indeed to small island nations in general), the introduction of the Gateway was largely championed and led by an individual staff member at the Ministry. This highlights two important characteristics of the education system in Iceland related to innovation: that there is potential space within the system for initiating innovative activity on the part of an individual, but also that, as is the case in other education systems in small nations, there is often a single critical point of failure if one key person were to leave the project.

In order to better maintain and sustain this innovation, the Ministry quickly decided to spin out the day-to-day operations of the Gateway to a private sector firm under a competitive tender process. This was done to better tap the technical expertise available in the private sector; such expertise is something that ministries of education all over the world find difficult to develop and maintain in-house. In addition, this arrangement allowed for more flexibility in the type of content included on the Gateway, as inclusion on a portal run by a private firm would not be seen as official sanction from the Ministry itself (unlike, for example, content created by the National Centre for Education Materials), while the link to the formal school sector in Iceland remained prominent.

In order to facilitate this transition, one staff member working at the Ministry moved over to the firm managing the site. While some may argue whether or not this approach to staffing constitutes an 'innovation' within the education sector, it is clear that the Ministry's flexible and pragmatic approach in this regard was crucial in ensuring consistency and strong informal linkages between the firm and the Ministry itself, and thus in sustaining the innovation in the short run.

3.2 Monitoring and evaluation

To date, the development of the Gateway has not been data-driven, and there has been little formal formative or summative assessment. In the early days of the project, this was perhaps not surprising, and indeed, one can imagine that, by the early part of the decade, the need for an educational gateway in Iceland was self-evident and there was a clear roadmap for the development of initial content on services on the Gateway, based on models from abroad and the general experience of project sponsors in using other web sites. Perhaps as a result of this informal initial development process, much of the monitoring and evaluation of the activities and impact of the Gateway have been informal and not systematized. Rudimentary site traffic statistics are available, but have not heavily influenced the development of the portal, though, for example, user visits were used as indicators when deciding to increase the news service. Systemic benchmarking of site performance against similar educational portals in other countries or roughly comparable portals servicing other sectors within Iceland was sometimes attempted but proved difficult to implement because of the way in which access and use were measured. As the Gateway appears poised to consider a next phase of innovation in the services it offers, an increased focus on

monitoring and evaluation metrics, including scrutiny by outside groups, could be an important tool in ensuring that the site remains useful, competitive – and indeed innovative.

3.3 Findings and lessons

On the Internet, what was new and fresh in 2003, when the Gateway site was officially launched, can appear old and stale a mere five years later. While new content, and new content areas, have appeared on the Gateway since its debut, no fundamental innovations have been introduced in the ways that content is developed, presented, organized and distributed. Recognizing this, the Ministry has decided to take management of the Gateway back in-house as a means to refresh the content and services the Gateway provides. While the Gateway can rightly be seen as an innovation within the Icelandic education system when it was introduced, characteristics of education portals (and web sites in general) now considered to be 'innovative' are for the most part not now in evidence. Indeed, many of the key innovations that have transformed the nature, usability and functionality of web sites since the debut of the Gateway have not yet been incorporated into the Gateway. These are commonly grouped under the general rubric of “Web 2.0” and are related to the sharing of content between web sites (via RSS, for example), allowing users to 'tag' content so that it can be organized and located in different ways (Flickr is one prominent example of this), and enabling and promoting user-generated content, especially through support for on-line communities of interest (e.g. Facebook).

The key mechanism used to find content on the Gateway is the site's search engine, which restricts user searches to educational content included in the Gateway index. Since 2003, however, the power and usefulness of Google and other Internet search engines have improved manifold, and as a result users seeking links to Icelandic education content may just as profitably use external search engines to locate such content than the site's own search tool. This is especially true in the absence of additional value-added by the Gateway – say, for example, if the Gateway explicitly rated individual content, and/or allowed its users to do so. As general search engines become more and more powerful, many sites have put more emphasis on using tagging to help users find more relevant content. Because most of the educational content on the "School Web", a subscription-based private web site that provides learning content to 98% of Icelandic schools, is password protected (see related case study), its content is not included in the Gateway index. Perhaps the best-known model for doing this – the way that Google News works with news providers to include descriptions of subscription-based content within its search index – appeared only after the Gateway was introduced. These observations are not meant to criticize the Gateway in its current form, but rather to emphasize the difficulties in staying innovative in the delivery of digital learning resources in the face of broader, fast-moving, disruptive innovations introduced into the wider Internet.

In many countries, the decision to promote the development of digital learning resources by the private sector is meant to promote innovation in the sector more generally. (Malaysia provides one good example of this.) There are other reasons to outsource the production of education content, of course, but promoting innovation can be an explicit policy goal, as was the case with the initial decision by the Ministry to outsource the maintenance of the Gateway. While it may not be appropriate to generalize to broadly from this one example, which may have been atypical in many regards, the decision by the Ministry to take the Gateway back in-house does at a minimum testify to potential difficulties in maintaining successful public-private partnerships in this regard over time, and thus to use this mechanism successfully to promote innovation in this area.

The case of Iceland's Education Gateway underscores two significant challenges to introducing and sustaining innovations within the Icelandic education system.

1. If, as many experts maintain, innovation comes about through the interaction and exchange of ideas and perspectives between people, how can a small system – especially one where

2. How can educational initiatives such as the Gateway continue to innovate in its products and services in the absence of keen and immediate competition, especially given that the education system itself is high-performing and the country so peaceful and prosperous?

The former president and CEO of Intel – itself one of the most innovative firms of the second half of the twentieth century – famously says that “only the paranoid survive”. Fear, especially induced by external threats to a system, can be an unwelcome but critical factor that promotes innovation within a system itself. Absent competition – and there doesn't appear to be many specific competitors for the Gateway at the moment within Iceland itself, and the use of the Icelandic language effectively prevents meaningful competition from sites and services outside Iceland – the impetus for innovation must largely come from within the system itself. It may be that, as in the case of the Gateway, innovations from abroad can simply be borrowed and adopted within the Icelandic education system. If so, this would advocate for Iceland continuing to maintain close links to its Nordic and European neighbours as a mechanism for introducing innovations related to the production, use and delivery of digital learning resources, rather than to actively promote innovation in this sector from within.

4. CASE A 2: NATIONAL CENTRE FOR EDUCATIONAL MATERIALS

The National Centre for Educational Materials provides compulsory schools in Iceland with educational materials, including online materials, videos and CD-ROMs. It is state-run and financed by annual budget allocations. The materials are aligned with the national curriculum, and the number of online publications has grown rapidly since the first appeared in 1999.

4.1 Key areas of innovation

The NCEM people we met set out two key areas in which they aim to excel: having the country's biggest collection of online educational material and being seen as leading innovation.

The first innovation is in providing supplementary materials online for printed text books. For example, the Centre provides the only text book for mathematics for 11 year olds and the text book is complemented by online games and interactive exercises, and materials for learners with special educational needs. Content ranges from PDF files with assignments and teacher guides to be printed out to a range of interactive learning materials, either stand-alone or linked to printed materials. The number of online titles has grown from 100 in 2002 to 380 in 2008, of which 120 are interactive web pages and the rest are PDF files, mainly teacher guides, worksheets and additional learning materials. About 40 to 50 videos are available online varying in length from 15 to 50 minutes. ‘Sound books’, used by learners with reading difficulties, are being put online. However, the oldest web-based content is eight years old and the predominant type of content published is the printed textbook which can remain in print for up to 20 years.

News-type material is increasingly popular with teachers and learners (who used the material unmediated by teachers), for example, websites which relate current news to past events like the Olympic Games. This material is developed by a person in a 50% post with this task, and material is updated daily, weekly and according to seasons. Thus, it becomes a growing repository of useful material for recurrent events in the year (e.g. Christmas and spring). Such a development highlights one advantage of online publishing over print: its capacity for being topical.

In all about nine members of staff take part in web developments and it is now customary to think about online aspects when new learning materials are being considered.

The materials are designed to support a predominant model of ICT use in classrooms in Iceland which appears to be to print off and use offline materials provided as PDFs, with some use of computer rooms for whole class access. There is commonly one internet-connected computer in classrooms, usually sited by the teacher's desk and intended for their use. Some of these computers are connected to digital projectors, but otherwise it is not easy to manage student use of computers deployed in this way. There are very few interactive whiteboards because there is not much frontal teaching – there is no selection or streaming in Iceland so classes can be highly heterogeneous – and so little demand for content that can be used in this way. Materials are also designed for the usual teaching model in Iceland which is individualised learning.

The Centre's web site (www.nams.is) is open and freely accessible, enabling learners to show their parents what materials they are using, and to work independently with them at home, a practice that teachers support. Teachers too tend to visit the site from home, where they browse and evaluate materials. This is eminently possible in Iceland, as the country has the highest level of home broadband in Europe (72% of households) and 88% of Icelanders use the Internet [source: Eurostat]. Moreover, some teachers are provided with their own laptops by the school.

4.2 Brokering relationships between stakeholders: exchange of knowledge and practice

The Centre is close to the Ministry of Education from whom its funding comes. The Ministry provides board members and chair the board.

The Centre has a quasi-monopoly of the compulsory education market in Iceland, usually providing the only text book for a particular subject and age group. It is aware of this dominant position and takes steps to justify its position and develop a two-way relationship with teachers, although one mainly based on the supplier-consumer model. From the evidence we have teachers are satisfied with the materials available from the Centre. Some teachers submit suggestions for publications and manuscripts to the Centre, of which typically one in 20 is accepted. The criteria for acceptance include match to the national curriculum, an existing need and a gap in the publications range. They receive payment for materials published. Icelandic teachers were characterised as 'individual working in their own corners', making the creation of communities of practice around online content problematic.

The Centre co-operates with Icelandic companies specialising in web-design and in the development of materials, and with Iceland's daily newspaper Morgunblaðið. However, unlike other countries, there is currently no relationship or co-operation with Iceland's public broadcaster and it does not make any programmes, archives or resources available online. There is some collaboration with other organisations, including the national art gallery, parliament, a marine research institution, a science institute and a weather station, but we were told that this was not going as well as had been hoped. The model for collaboration appears to be based on an expectation that the partner should provide content to the Centre (preferably at no cost) to be turned into educational material. The possibility of the newspaper publishing Centre materials was not welcomed (or feasible).

4.3 Implementing the innovation

The Centre's budget is split between online and print materials, with online growing to the present 15 %. We were told that the allocation of funds between the two was based on gut feeling rather than empirical evidence and on a need to respect teachers' preference for printed books.

The Centre makes audio books and educational videos available online that can be downloaded to MP3 players but they do not yet make use of social networking tools and services or publish specifically for

mobile devices. The whole site is being designed so that students can access material directly, without teacher mediation, and this is a relatively unusual development.

Yet the innovation could perhaps be more radical. Several people we met talked about the inflexibility of the school system, a certain degree of 'coasting or even under-performance ('We are behind other nations in providing educational resources or teacher training') and the slow pace of change. For example there is little distance learning in schools (compared to what is happening in Iceland's continuing and vocational education sector) despite the high levels of connectivity – secondary schools have had broadband (at 100 MB/s) for five years. The Centre, with other stakeholders, could play a part in more boldly modelling alternative ways of teaching and learning.

4.4 Monitoring and evaluation

The Centre is a member of two international associations of educational publishers. This is one of the primary means by which it benchmarks itself internationally, notably against Scandinavian countries, Germany, France and Spain. Developments outside Iceland are monitored: the editors have attended courses in Utrecht on web editing, and NCEM staff goes annually to the BETT show in London.

The Centre obtains feedback within the country on its products and services during annual tours of Iceland to talk to people in schools. New textbooks are published when the national curriculum is revised; existing textbooks are revised when the Centre staff 'feel' that they are getting out of date and when teachers begin asking when the NCEM are going to revise the book.

The number of weekly users of the NCEM site has risen from 2,174 in 2003 to over 11,000 in 2008, although we were not informed of any targets against which this growth could be benchmarked. A formal survey showed high levels (95 %) of teacher satisfaction with the Centre's output, teachers reporting daily use of their materials and satisfaction with the web site ('If you go to the National Centre you are sure to find what you want' said one). Only three to four percent felt that the lack of material online or in Icelandic hindered their use of computers. (The factor attracting almost 50 % agreement by teachers was that the subject does not lend itself to being taught via computers, making Iceland's teachers among the least motivated in Europe to use ICT, suggesting that some efforts could be made to explain and illustrate how ICT can support subject learning.) The views of children do not appear to have been sought.

However this feedback does not appear to be used to feed into a vision for the future, or a medium-term development plan, other than an expectation that schools will be using DLRs more and more (though it was said to be happening more slowly than was thought it would). We were told that no one knows what the future of DLR publishing will look like in five years, though in fact there is no shortage of ideas worldwide. With one computer connected to a projector in every classroom, rather than computers in computer rooms, there would be more uptake, according to the person we talked to. The new legislation for schools introduced this year might help people at the Centre consider how they will provide DLRs that provide more student choice, community involvement and personalised learning – three of the key elements of the new legislation (of which many people we met were ignorant)

Teachers and principals in up to eight schools are asked annually whether the website is useful, attractive, promotes creativity, is motivating, makes learning easier, is accessible and well-organised.. Formal surveys have been carried out by the NCEM itself and by the Ministry and some are carried out under contract by private companies.

Uptake of the online materials is lower than hoped for (but no measurable target was set). There appears to be no data to explain this and the respondent could only guess at the reasons for this. It may be that the way computers tend to be deployed in schools did not fit in with what the Centre was doing. Schools, we were told, generally had a single computer in classrooms and once a week use of computer rooms, making

it difficult for teachers to use online resources. Research results are not used in any direct way in the preparation of web-sites.

More generally, accountability levels in Iceland's school system tend to be lower than in other countries, possibly because of the small population (people in education know each other and grew up together), a coalition government (school education is not a political issue) and high levels of trust between stakeholders – for example the teacher union and the government – who in other countries might be more confrontational.

4.5 Findings and lessons

- The use of the NCEM website is growing steadily, but not as much as was hoped. Digital resources are here to stay and their development continues.
- It appears to be difficult to align the use of online materials with traditional classroom teaching.
- The presence of a dominant albeit well-meaning and well-regarded player tends to stifle competition, especially when the school system is judged successful by most stakeholders and in a country with no unemployment. Such a position makes it incumbent upon the Centre to do more to lead innovation, stimulate and experiment, help develop new talent and model new ways of teaching and learning, and of exploiting technology.
- Cooperation with some private ICT companies has been successful. Iceland aims to be an e-nation, among the leading nations in the use of ICT we were often told, and the private sector has gained much from the conditions under which they operate and the workforce that schools provide. Despite efforts over the years there is little evidence of private sector partnership with the public sector and indeed some hostility within the public sector to private sector involvement in education. Nevertheless we feel that efforts should be maintained and the Centre could play a key role in this, for example by outsourcing some activities or playing a role as commissioner of content for areas where there is likely to be competition of provision, the core schools subjects for example.
- System-wide measures could do much to stimulate change and the development of innovative DLRs. Under the current regime, it is possible for a teacher to teach the national curriculum in all subjects except ICT without using computers. Career progression and pay increments are not currently linked to teachers' use of ICT.

5. CASE STUDY A 3: THE SCHOOL WEB

5.1 Identifying key areas of innovation

Adopting the open and tailored OECD definition of innovation as 'any kind of change that is introduced with the aim of improving the operation of educational systems, their performance, the perceived satisfaction of the main stakeholders, or all of them at the same time' (OECD 2007), the individual's drive and motivation to produce such change becomes a pivotal element. Top-down processes are in Iceland sometimes conceived of as hindrances, harnessing those implementations of change originating in an individual. In fact, while innovation is a bottom-up process and implementation of innovations is too, the former can happen almost spontaneously and autonomously, while the latter requires money handed out by policy makers in top-down fashion.

The **School Web** is a Web site (*skolavefurinn.is*) that since the year 2000 provides digital material aligned with the national curriculum. Access is for the most part restricted to subscribers and Web pages are marked with a copyright symbol. The site is one of the largest in Iceland, measured in content as well as in unique number of visitors. Many colleges and 98% of compulsory schools in the country subscribe. Operations are currently run as a commercial company with a staff of around ten people that do mainly editorial work, and that outsource technical work (e.g., filming) whenever required. The core staff is made up of editors, content creators, production specialists and general office staff. Teachers and other content creators are then contracted as needed. The Web design is simple (if sometimes cluttered), page loading is swift, and audio material is high quality with problem-free playback.

Considering systemic innovation, the term ‘systemic’ in a way negates the reductionist rationale by which key areas are identified, in its claim of the whole being larger than the sum of its parts. Therefore, there is room for innovation wherever and whenever the ‘system’, in this case the system incorporating all relevant aspects of Icelandic compulsory education, is a breeding ground for new initiatives, bottom-up as well as top-down. The magic of innovation, and the diffusion of its produce, has proved itself describable in governmental (Hägerstrand, 1953), academic (Rogers, 1962), and industrial (Kelley, 2006) systemic terminology. After decades of discrepancies with traditional economic literature, systemic approaches to linking educational attainment to economic growth have also recently succeeded in explaining the importance of society investing in education (Lutz, Cuaresma, Sanderson, 2008). What makes Iceland different from almost all other countries is its vulnerability to systemic change. Oversights in policy or laws can have devastating consequences for future developments, including innovation, because of the small population and language, and the country’s geography. The government’s support of the first years of development of School Web is a good example of money well spent, since in retrospect that money helped overcome significant demographic and geographic problems by digitally tying together teachers in rural and city areas.

5.2 Brokering relationships between stakeholders: Exchange of knowledge and practice

Nowhere is the bottom-up/top-down DLR interplay more important than at schools, where the individual teacher is typically both wrestling with and benefiting from school management interaction (Wang, 2008). In Iceland, broadband net access is not a bottleneck (EC, 2006). At schools, access to computers can be a problem, and teachers as well as pupils unsurprisingly seem more likely to use computers for educational purposes at home (where computer and Internet access is modern, relaxed, customized, and unfiltered) than at schools, cf. (Luke, 2008). Hence, any management-anchored DLR-strategy entails an understanding of flexibility in computer use with respect to time and place, not only by staff teachers but by also by their pupils. This leaves room for Web sites such as School Web in the strategies. Regarding criteria for quality and use, the choice of tools could (at least in theory) be made by a management keeping in mind that DLR-tools come with a variety of built-in quantitative measures. The real challenge for management is to amalgamate these with other adopted measures, including qualitative ones, and in this way get the whole picture of how successful the DLR-strategy is. For example, to simply count the number of hours spent working with a particular tool by the average pupil in the average class will not contribute much to that whole picture. That said, School Web user traffic could be made available to schools, even if there is no way to categorize traffic from teachers, parents, and pupils. Privacy need not be an issue here, since individual IP numbers need not be used to link a user’s geographical region to a particular school.

5.3 Knowledge sources and types

School Web has very little competition, and given that most of the content is in Icelandic this is not expected to change. Teachers have over time turned towards the **Educational Gateway** (CASE A1), now the official national portal for curriculum and classroom materials run by the MESC, for classroom material and practical information. School Web has no formal cooperation with national broadcasting (TV

and radio), leaving many so-called mash-ups and podcasting out of their service portfolio. This seems out of step with current developments, and Web 2.0 services are now reportedly on the School Web agenda. Asked why they have chosen not to run the company as an open source development project, representatives spoke of the amount of person hours invested over ten years, and that especially the teacher involvement might hinge on the fact that the perceived value and status of the site is higher with paid subscriptions. In addition, an open source project also requires careful maintenance, in particular if user participation is high. Perhaps more surprisingly, there is no Creative Commons licensing of site material, but in the last two years School Web has been involved in European Schoolnet where such licensing is a promoted issue.

5.4 Implementing the innovation

In DLR, bottom-up implementation of individual innovation usually becomes a tangible; either a digital artefact (e.g., a computer program, a database, a data repository), or a describable and easily applicable method or service (e.g., a manual for information retrieval from a specific database). At the best of times, the implementation provides something that the system served by corporate or governmental service provisioning is currently lacking, by means of individual service provisioning (Espinoza, 2003). Such user-driven development have in recent years been propelled by simple and open application programming interfaces being made available by and for a community, with *facebook.com* being the most cited example. The tangibles then become deliverables of a project that was awarded funding through what in Iceland is a top-down political process, the money coming from the Ministry of Education, Science and Culture (MESCS) or from local authorities.

The first two years of development of School Web relied heavily on government grants. The original business case had teachers as the main clients, with the devise 'for teachers by teachers' as the three founders were all teachers, but the service is increasingly targeting parents. Parents early on become aware of the site's existence, since almost half of the kindergartens subscribe to School Web. No pilot site was made, but the incrementally added content is usually piloted with teachers before it is made generally available through the site. Those teachers belong to a small set of pilot schools that the School Web editors have established a long-term relationship with.

The School Web is not adapted for browsing on mobile clients even though much of the material is suited for viewing on a modern Java-enabled cell phone, such as the Icelandic sagas in text and audio implemented in standard fashion. The site has grown rather slowly, if steadily, with the bulk of material being provided by contracted teachers and then finalized together with the editorial staff (and test users, as necessary). This has meant that the transition from html- and PDF-files to multimedia has benefited from the drop in hard disk prices, so that the company development has not been constrained by investments in expensive Web service technology. Recently, textbooks and CDs have been produced. The selection of offline titles was made based on customer requests, obviously filling a void in that market, since sales are reportedly very good. Success can perhaps be explained by funds being made available to schools from the government allowing schools to buy educational materials from private companies. Traditionally, schools were expected to get their materials from the NCEM.

5.5 Monitoring

In School Web, teachers provide continuous feedback upon using site material in class. Some contributors are asked to revise older material, as necessary. The claim that the company actually listens to its users is substantiated by the recent move into offline material, and subsequent good sales reported on books and CDs. The fact that most schools are subscribers also creates excellent opportunities for feedback and monitoring.

5.6 Evaluation

The editors of School Web have adopted a set of criteria for establishing the link from new material to the national curriculum. The site material is seemingly enjoying high popularity among its users, as witnessed by the large amount of subscribers and the successful business venture. Material is submitted chiefly by contracted teachers and is subjected to editorial review and selection procedure. Approved submissions are always paid for, providing the double incentive of a mark of quality as well as monetary reward. Some teachers have to work very hard to further refine their material in several iterations, using feedback from pilot schools and from the editors. Even if much of the material is standard, the procedure allows for more innovative pedagogy to reach a broad audience. The wide dissemination of the material is a bonus incentive for teachers, in that the pleasure of witnessing colleagues use their material in class is strong.

5.7 Findings and lessons

A key area of innovation is teacher motivation. In the case of the School Web, the staff could not produce their own material, but must rely heavily on submissions from teachers. Teacher enthusiasm should arguably be used to find shortcomings and faults in current ICT tools and technologies. In this way, the enthusiastic teacher can affect requirements specifications for hardware and software, and get their input passed along to school management (for local decision making) or policy makers (for grant applications and national political input). This chain shows three of the stakeholders: teachers, school management, and politicians. The 45 000 pupils in compulsory schooling and their parents are two more stakeholders, with local industry representatives constituting the final group. It is somewhat unnerving to witness the relatively low motivation in teachers in Iceland, as recently reported by Empirica (EC, 2006, p.5): “a very high 47% express the opinion that using ICT in class does not reveal significant benefits for pupils, i.e. are not very motivated for ICT use in class”. A follow-up question relevant to innovation would be if teachers presume that pupils use ICT outside class in their school work (at home, in the school library, or at an Internet café). The reply would be interesting since “Icelandic teachers are very positive towards the use of ICT in class” (*ibid.*) and teachers have the ICT skills and equipment needed.

Community involvement in School Web is sometimes manifested in unexpected and innovative ways. A 72-year old man reading texts in old Icelandic, which many younger people would find difficult to read and present, is very popular among listeners, and several other senior citizens have as a result been employed by the site.

The future business model of School Web could do worse than looking at international alternative solutions, such as the free Swedish site *lektion.se*, cf. (Hylén and Skarin, 2007). With more than 160 000 subscribers, *lektion.se* has become much more of a meeting place for teachers (and to a much less extent, for parents) than has School Web. School Web material is often simply accessed as a PDF file and then printed and distributed to class. Incidentally, given the sharp drop in projector prices, one would expect to find a roof-mounted or at least portable projector in every classroom, but this is not the case. If projectors were there, those PDF files, and more importantly interactive material, from School Web could be used in class with less printouts and more pupil interaction as expected results. At the outset, the PDF files were provided as a means to archiving digitally, and without degradation, material for photocopying; reducing printing is the logical next step.

6. CASE STUDY B 4: THE LANGUAGE STUDIO

The Language Studio (<http://laugalaekjarskoli.is/tung>) seeks to develop, and to coordinate the development of, web-based learning and distance teaching in foreign languages in compulsory schools in Iceland. It targets students already competent in Norwegian, Swedish, English or Danish wishing to

become more advance and competent in the languages they have already studied and in accordance with their age and maturity. It provides general advisory services for foreign language teachers in Iceland, especially teachers of Norwegian and Swedish. (Language Studio instructors have recently started to teach Polish and Tagalog.) The development, provision and dissemination of digital learning resources is a primary activity of the Language Studio, which has received many awards, both within Iceland and from groups in Europe, for its innovative approach to language learning. The Studio itself is quite small, with a half dozen instructors. Initially it relied on the services of a single part-time programmer (at times based abroad!), but it now depends on technical infrastructure (Blackboard) maintained by the education authorities in Reykjavik.

6.1 Implementing the innovation

The precursor to today's Language Studio was born in the late 1990s to help address a shortage of instructors in (first) Norwegian and (then) Swedish to help meet the needs of foreign language learners dispersed throughout the large (relative to its population) land mass of Iceland. Originally funded through a grant from the Nordic Council, initial activities focused on the development of an educational web site for lower secondary students already familiar with Norwegian or Swedish and who wished to study one of these languages rather than Danish, which is a part of the official national curriculum in Iceland's schools.

In form and substance, the Language Studio is largely similar to virtual language learning centres in other countries. This is not to say that it is not innovative – far from it. It is clear that it is staffed with innovative instructors, and these instructors are using the Internet in innovative ways to provide foreign language instruction at a distance. The Language Studio makes extensive use of a web-based message board and web-based resources, of its own creation and, to a lesser extent, from other sources on the Internet. Foreign language teachers in many countries – at least the good ones – typically operate with a fair degree of autonomy, and are often quite free to innovate in their choices of educational materials and delivery mechanisms and styles; this is quite evidently the case with the instructors employed at the Language Studio. This points to one potentially key characteristic of a successfully sustained innovation in digital learning resources; namely, that it may be easier to introduce and sustain an innovation in an area or topic already known for innovation, and where key actors are already inclined to innovate.

While the Language Studio provides a virtual learning environment, it is interesting to note that it is actually physically housed within a public compulsory school in Reykjavik (Laugarlækjaskóli). One reason for doing this was to provide a more traditional school environment for instructors as their home base to promote the exchange of information and esprit de corps typical of teachers in Icelandic schools. While this may change – there is talk that the Language Studio could physically somewhere else, such as the University of Iceland, where they could be closer interaction with faculty and students there – it is notable that the physical location of project proponents can potentially be an important component of an initiative in digital learning.

Next to the National Centre for Education Materials, the Language Studio is the longest-running and most 'institutionalized' of the innovations examined in this study. This institutional nature of the Studio – it is relatively well-funded and formally housed within a public school – leaves little doubt that the project, and its innovations, will be sustained for the foreseeable future. That said, some of the growing pains typical of the innovative projects as they are institutionalized as part of larger bureaucracies were in evidence when the study team visited. While in the early days the Studio had a great deal of flexibility with regards to the technical set-up of the on-line system that they used, it now runs on the Reykjavik's city-wide Blackboard educational learning management system. There are strong advantages to this: Language Studio employees are not terribly technical, being trained as language teachers, and integration within the learning management system employed more widely in the formal school system has administrative advantages, but drawbacks as well. A botched upgrade to the LMS resulted in the Language Studio being off-line when the study team visited, and Language Studio staff could do nothing but wait until the system

was restored to resume delivery of their services over the Internet. The network does not, for some reason, allow the use of Skype or other VOIP services commonly used by other virtual foreign language learning environments. Language Studio staff therefore schedule regular telephone conversations with students, an innovation that the near ubiquity of mobile phones in Iceland certainly enables.

As with many other innovations in Iceland's education system related to the use of digital learning resources, the Language Studio has been largely promoted, guided and driven by the efforts of a single innovator. This highlights both the importance of the actions of a single individual in introducing and driving innovation in Iceland forward in this area, and the potential fragility of such an innovation, at last in its early days, should this person no longer be involved with the project.

6.2 Monitoring and evaluation

While formal summative evaluations of the impact of the Language Studio were not apparent, it is clear that there is a great deal of informal formative evaluation of the project by both Language Studio instructors and, to a lesser extent, learners. There is a form of market test for Language Studio services, as schools outside the city of Reykjavík, must sign on and pay for its services, and this presumably provides an important regular feedback loop. It is not clear to what extent Language Studio principals have formally benchmarked its services against similar offerings in other countries, or against private services in Iceland offering language instruction over the Internet. That said, the project leader, and to a lesser extent all project staff, appear to be in close touch with developments and counterparts within Iceland and in other countries involved in foreign language instruction, and are explicitly interested in doing this, both professionally and personally. Again, this is not surprising, given the subject matter. That said, given the small project staff, there is only so much regular knowledge exchange that can occur with counterparts in other places, and formal independent outside comparative reviews of the operations and impact of the work of the Language Studio were not in evidence.

6.3 Findings and lessons

To perhaps a greater extent than most of the other cases examined in this paper, the Language Studio faces more explicit immediate and potential competitive pressures to its core product that could potentially compel the project to continue to innovate in its use of digital learning resources. Schools are not obliged to buy its services, and could instead decide to hire teachers locally, or elect to purchase targeted language instruction services for students from other providers over the Internet. As local schools have a large degree of autonomy in use of funds, such vendor choice is theoretically possible, especially as educational services becoming increasingly globalized and because Internet connectivity is so good in Iceland, making high quality interactions with foreign language instructors in (for example) Sweden or Norway technically possible. This is not to say that this is a likelihood in the near term, especially given the large first mover advantages that the Language Studio has in this area and the fact that it is much closer to its 'customers' -- foreign language students in Iceland, and the schools that house them -- than foreign competitors could ever be. But it highlights the fact that a potential for competition could prompt continued innovation in the delivery of the Language Studio's core services to a greater extent, perhaps, than other cases examined in this study.

7. CASE STUDY B 5: THE KATLA WEB

7.1 Identifying key areas of innovation

The **Katla Web** is an interactive Web-based program for foreign students that want to learn Icelandic, situated on the site www.netskoli.is/katla. The older site has some interactive material freely available for review, and also links to 20 academic publications on foreign language studies. Katla Web holds books

and other materials, divided into 19 sections and printable from PDF files. Material is copyrighted and reserved for subscribers. The two developers worked at reception centres for foreign students in two primary schools in Reykjavík in 2000-2007. In 2002, the two initiated Katla Web and the first site was launched in 2004.

7.2 Brokering relationships between stakeholders: Exchange of knowledge and practice

For immigrants (and to a smaller extent for Icelandic families that have emigrated), Katla Web can be a complement to second language courses in Icelandic schools. The pedagogy is chapter-based mastery learning of vocabulary, grammar, and phonetics. An important hypothesis for efficient learning adopted by Katla Web developers is that foreign students cannot easily adhere to the national curriculum, but need their own.

7.3 Knowledge sources and types

Katla Web like other parts of the Language Studio seems to be in limbo, currently without plans for open access or new ideas related to licensing.

7.4 Implementing the innovation

The Katla Web is not absolutely linked to education in compulsory schools, since many of its users could take the interactive course at their leisure, e.g. from home in the evening, or even from abroad. Students can thus log on to Katla Web from any computer, inside or outside the classroom, and translations of words in Icelandic language are offered to up to 12 other languages for each new word in the vocabulary.

The government has awarded the two developers several grants over the years, and writing proposals and aligning with government policies on education has taken a substantial amount of the developers' time. A total of 13 grants at local and national level have been awarded so far, including two from private companies. One of the developers is co-leading a research project named 'Icelandic as a second language: Long-term research on the language skills of young immigrants' which received a three-year grant from the Icelandic Research Fund, but its impact on and relevance for Katla Web development is unclear. The company increased the subscription fee in 2008, causing a dramatic drop at first in the number of subscribing schools (from 30 to 4), and possibly jeopardizing the future of the site. The developers went on a publicity campaign adding over 30 new subscribers, as the subscription fee was lowered by 1/3.

7.5 Monitoring

In Katla Web, teachers can monitor each student's progress through interactive books in 15 chapters, where minimum levels of mastery must be reached in order to proceed. Developers apparently do not use Web traffic data to refine their interactive material, which is remarkable.

7.6 Evaluation

The two Katla Web developers have a strong interest in research on second language learning, and they organised a conference on the topic in 2006. They have also maintained cooperation with researchers in the U.S. and Canada, initiated during their time as teachers and researchers. No evaluation of Katla Web has been made so far, and school use is only informally followed up on.

7.7 Findings and lessons

The small number of immigrants to Iceland is comparable to the numbers in Norway and Finland, and hence second language learning companies in those countries could provide important clues for new business models. Katla Web is certainly in need of new business ideas, given their recent failure with respect to market research resulting in the drastic drop in subscribing schools. Katla Web is now basically

run on evenings and weekends by one mother-of-four writer and one Web developer, in sharp contrast to the profitable and well staffed company in charge of School Web. If Katla Web were to disappear, it would leave a gaping hole that could prove costly to fill by other means, but the responsibility for maintaining, developing and securing the future of Katla Web is today unclear, with neither MESC nor local authorities stepping forward.

8. CASE STUDY B 6: ICE-KIDS

The aim of this innovation was to create a web-based platform and a school and community for young expatriate Icelanders to keep up their mother tongue through courses, games and community in a safe online environment.

8.1 Key areas of innovation

There are two areas of innovation: the Learning Management System itself and the activities and communities within it.

The LMS, called Netskólinn (Net School, <http://www.netskoli.is/adalsida.asp?Stofnun=1>) is available in English and Icelandic. Unfortunately we were unable to register and therefore log in but we were informed that the system tracks learner progress (that parents can view), enables teachers to create web-based courses (using a built in word processor), provides forums, age-based clubs, activities and assignments, tests progress and has a mail and filing system for teachers and learners. Individual net schools can be created.

All activities and content (games, newsletters for parents, courses, tests, discussions) using the LMS were developed by the teacher working closely with a programmer – a former teacher – who was paid a small amount to turn the ideas into working reality. An online course took place in the school year 2003-4 and others in 2005.

The innovation was initiated at the Iceland University of Education and was essentially bottom up. Other stakeholders were the ministry of education, Icelandic families living abroad and a number of sponsors. There was an absence of engagement and therefore ownership from schools, companies and the foreign ministry, not having been involved from the outset when the project was ministry of education funded. It was not clear how the need for the project was identified, i.e. prior market research, but the response of parents was a strong motivating factor.

Also innovative is the fact that in Iceland it is a straightforward matter for a teacher to set up a business, and therefore to be eligible for grants available to the private sector.

8.2 Brokering relationships between stakeholders: exchange of knowledge and practice

The end users were parents and children. The project did not impinge on the national education system or pose a threat to any existing service or practice, and therefore operated outside the usual system to some extent.

The involvement of trainee teachers and working in an office alongside other projects enabled some exchange of knowledge and practice. The shared use of the programmer also acted as a bridge between these projects.

8.3 Knowledge sources and types

The project team gained knowledge related to distance learning, web site development, developing learning materials, programming and teaching Icelandic. The team benefited from the programmer's skills in interpreting their ideas. Children were contributors to the project through their collaborative activities and contributions to blogs and communities.

There are undoubtedly examples of good practice in the content, tools and activities developed but they are contained within the LMS and so not easily accessible by others.

8.4 Implementing the innovation

Iceland University of Education led the innovation and one person was the project champion and leader, supported by the programmer and other teachers. They took on students teachers of ICT to help on the courses. The current three-strong team is based in Iceland, Denmark and Italy.

The first phase in 2003 was jointly funded by the Ministry of Education, Science and Culture and the Ministry of Foreign Affairs and managed by the Continuing Education Department. Most of the budget went on developing a learning management system from scratch. This was described as expensive. The LMS was launched in autumn 2003 to all potential users and new features were added as the need arose.

In phase 2 (from 2004) the project was funded by Netmennt a private company of teachers with experience living abroad. In this phase there was a focus on community building and communication, in an online school, run from the Iceland University of Education.

Efforts in the final phase were focused on securing funding for the future of the project; private sector funding was obtained but difficult to sustain – i.e. no repeat funding from the same source. The project is closed to new users but remains open to existing users and the platform is still in use with blogs, clubs for different age groups and a penpal service using MSN and Skype. Over the project duration from 2001 to date, 1 000 children aged three to 18 (of whom 200 were active) in 40 countries used the service.

The project initiator and leader is proud of the project. She established the Netmennt business as a vehicle to attract and process funding for this project. The service was intended to be self-funded after ministry of education pump-priming through contributions and subscriptions – set low at 90 euros a year – from parents abroad (a significant proportion of the population spends some time working and studying abroad), companies whose employees were posted abroad and the Icelandic Foreign Ministry. In fact parents were reluctant to pay because they do not have to pay for text books when they are abroad; they are supplied free by the NCEM and there is a general belief that it is the responsibility of government not parents to pay for children's education. Some companies provided one-off but not regular sponsorship and the Foreign Ministry did not consider that it was its responsibility to fund this activity. An application for regular funding from the ministry of education was submitted by Netmennt 18 months ago but no response has yet been received and the company is being closed down because of difficulties in cooperation. The project leader is in talks with Reykjavik municipality to integrate Ice Kids within a school language centre and adapt it to meet the needs of immigrant children. She agreed that a subscription-based model might be viable but she freely admitted that she is not a business person and did not have the requisite expertise.

Despite the ambitious target of creating a LMS, it was indeed completed and worked. Numbers of users were high and the project was well marketed to the potential target group. The uncertainty of future funding, and consequent stop-start activity, was the main difficulty.

The outstanding enablers of the project were the energies and skills of the teacher and programmer, who were incentivised more by the enthusiastic response of children and parents than money.

8.5 Monitoring and evaluation

The project was monitored formatively by the project team as it developed making use of evidence of children's use of the online school but the results were not shared outside the project. This enabled the activities to be fine-tuned and new ones developed in line with children's interests and usage patterns. However, this development work proceeded in a relatively unplanned way, and was not always matched to the available or foreseen budget.

As with much innovation in Iceland, evaluation was light-touch and unstructured, largely based on annual surveys of parents and self-evaluation. The project team said that they were proud of the innovation, suggesting that their evaluation of it was very positive, but we were not presented with hard evidence of this, other than numbers of users and examples of children's contributions to blogs and communities. It seems that children abroad learn Icelandic using the online school and benefit from it socially and culturally.

Thus, it appears that the innovation met its aims and the needs of end users and the funding achieved its objectives.

The lack of evaluative evidence however has made it difficult for the project to make a reasoned case for continued funding. On the other hand, in a small close-knit community where, we were often told, everyone knows each other, hard-headed evaluation and measurement may be counter-productive and more subtle measures may be more appropriate.

8.6 Findings and lessons

- The project could become sustainable with the support of municipalities and a wider set of partners for online teaching of Icelandic to immigrants. The content could be used in Icelandic schools and to help immigrants learn Icelandic but this has not happened even though there are close links with Katla Web.
- The value of working with a programmer with a teaching background was a key feature of this innovation. The project enabled the team to build up experience in readiness for what could be a more substantial project related to teaching Icelandic to immigrants. Projects like this require a team of teachers, graphic artists, designers and programmers.
- It was perhaps unwise to assume that government pump-priming would be followed by funding from other sources without thoroughly building up a business case. It is difficult to build up the long-term future of an innovation driven by passion and ad hoc development without a corresponding business plan and entrepreneurial and business expertise in or available to the team
- Providing content and services for users who lack a collective political voice or champion is risky.

9. GENERAL CONCLUSIONS

An examination of six case studies related to innovative uses of digital learning resources in Iceland highlights a set of key questions:

How to innovate a system performing well?

The Icelandic education system appears to be functioning well, a situation that could both promote and retard further innovation in the sector. This appears true both in a general sense, and in the specific case of the use and role of digital learning resources in the delivery of education services. To a noteworthy degree, although in common with many other small island nations, the education system seems to be less susceptible to external and internal pressures for reform than in many other European nations, and care must be taken that this inherent conservatism does not inhibit the use of potential levers to promote systemic innovations. Like established economies throughout the world, Iceland is grappling with some basic fundamental issues: What should the school of the future look like, and how can information and communication technologies be harnessed to improve the delivery of educational services in support of the country's larger developmental and educational objectives? In Iceland, answers to such fundamental questions must necessarily be coloured by a number of key cultural and contextual factors, including the country's relative isolation, unique language and ethnic homogeneity, and positive attitudes within society toward education. Education authorities in Iceland are challenged to be bold in their contemplation of imagined futures, to envision a wide variety of best and worst case scenarios, as a means to 'future-proof' the planning for educational initiatives to promote systemic innovation going forward, in the specific case of the use of digital learning resources and more broadly.

How and to what extent is (and should) such the system monitored?

There seems to be a lack of formal systematic evaluation and feedback, as for example for the NCEM regarding the uptake and satisfaction regarding published learning resources. Related to this is the question of the knowledge base for government spending on DLR, which seem weak. Are investments done more on gut feeling than on solid data? There seems also to be a need to strengthening teachers' skills in self-evaluation of their teaching and the school's performance.

The stylized sociogram on the front page of a recently published government policy report (Prime Minister, 2008) illustrates, accident or not, precisely what Iceland needs: a digital commons for teachers. More technically, the RSS feeds and syndication, ontologies, tagging and semantic web tools, and the clearing houses for digital rights management seem to be missing from the vocabulary and competence among teachers. Moreover, basic knowledge about information retrieval and archiving is not there in all teachers, and school management seems out of step with technological development, making DLR- and innovation management in schools unnecessarily difficult. At the national level, securing efficient monitoring and evaluation of ICT in schools has been identified as an important problem of today's school system, and a new legislation was accepted this spring to rectify this situation.

Are there ways to minimize the vulnerability of the system caused by the limited size of the population?

In small countries innovations and projects run greater risks of failure if a key person leaves it. This risk might be minimized by cultivating a culture where development work is done in teams, is documented and peer reviewed. In countries with a larger population there is more capacity in the system to find possible replacements.

What are the examples outside Iceland relevant to the Icelandic situation, and to what extent can benchmarking used as a way to improve and further innovate?

Given the small size of the Icelandic population and its cultural homogeneity, more concerted efforts to look abroad for ideas and experiences might help ameliorate the real dangers of complacency and insularity. The lack of enthusiasm for using ICT among Iceland's teachers stands out compared with other countries in the most recent Empirica benchmarking study, which showed that almost 50 % of teachers agreed that their subject did not lend itself to being taught via computers. Alone among European nations there are far more teachers here who are not convinced of the value of ICT in teaching their subject. This

is not to say that ICT use is always recommended as part of educational activities, or even desirable. However, given the capacity of ICT use to help enable and promote innovative practices, perhaps more concerted and widespread efforts should be made to demonstrate in various ways (i.e. subject by subject exemplification and training) ICT use may be relevant. Possible candidates for benchmarking and exchange of experiences are the other Nordic countries, where there is a strong tradition of cooperation, the countries of European Union and organizations participating in the European Schoolnet. In addition, also Scotland, Malta, countries with small linguistic communities in central Europe, parts of Canada and USA and the small Southeast Asian island of nation may also provide useful models for comparison and contrast.

Is there a need for structural measures to stimulate change and the development of innovative DLRs?

A teacher can teach the national curriculum in all subjects except ICT, and students can follow it, without using ICT; there is no pupil entitlement to the use of ICT or expectations that teachers should use technological tools, services or digital content. Countries that build in such expectations and entitlements have higher levels of ICT use.

In common with the situation in many other countries, the geography of the deployment of computers within Icelandic schools – especially where they are set apart in computer laboratories – inhibits their usefulness. It would be more productive if computers were moved into classrooms, or even corridors and open spaces, from computer rooms. Likewise technical support seemed to be missing in schools, so that teachers found that laptops, for example, were unusable. There appeared to be a lack of sense of community between teachers and there are few places where they can meet and share experiences either on or off line (e.g. local teachers' centres). If a particular product becomes the country's learning platform there could be problems. There should be trials to compare the different products, and the results of international studies should be taken into account. The views of teachers rather than administrators or technical experts should count for more. Municipalities have new responsibilities under the new regulations but they may not have the personnel or facilities to meet expectations.

The innovations we have seen tend to be top down and based on a 'build it and they will come' attitude. More effort at public relations, communication and marketing of products and services could pay off. Indeed a more business-like approach to planning, managing and evaluating initiatives could pay dividends, and support offered to entrepreneurial teachers to develop a business sense, or at least access it in others. In this small country with its unique language it is difficult to have a thriving market for educational content and there are several de facto monopoly providers who have little incentive to improve. When they are quite large and dominant, it is difficult for new entrants to make headway.

How are intellectual property issues to be addressed?

There is no overarching Icelandic strategy to ensure that stakeholders in the educational system have the right to use digital resources produced with public funding. Instead the impression is that a "silo mentality" is dominant, where each player manages the digital rights in an individual manner. The idea of a "digital common" seems to be missing. Iceland, for instance, is the only Nordic country where there is no cooperation between the school sector and the national broadcasting company or agreement that schools can access such materials for free.

Could better dissemination and appropriation of positive examples from other countries enhance teachers' knowledge on the advances in DLR and thus better exploit the opportunities for integrating ICT into teaching and learning?

There seem to be a lack of taking advantage of the strong Icelandic emphasis on practical subjects in schools, an area where DLRs could certainly make a difference.

Are there any moves to push companies to develop corporate social responsibilities and thus increase the numbers of public private partnerships in the educational sector?

To what extent is the private sector engaged in the public education sector, and is there a role for the private sector in helping to promote and facilitate innovative practices, especially as they relate to the use of digital learning resources?

In many education systems, public-private partnerships are seen as key levers for helping enable education reform, especially where such reform is facilitated by the introduction and use of information and communication technologies. This generally happens for a number of inter-related reasons, including (1) a belief that innovation related to the use of technology is something at which the private sector is quite good; (2) a lack of sufficient human resources within the formal education sector with the requisite technical skills, experience and perspective to promote innovation enabled by ICTs; (3) inadequate financial resources and/or sufficiently flexible financing mechanisms within the public sector to support and implement new innovations related to the use of ICTs, especially in their early stages; and (4) the existence of existing corporate social responsibility initiatives and impulses which can be leveraged to support innovative new practices in the education sector, especially as they may relate to the use of new technologies. Given the apparent current low level of private sector involvement in supporting public education in Iceland in this area, there appears to be much scope for exploring greater use of public-private partnerships to help promote pilot innovations which may lead, down the road, to more systemic reforms in the education sector. There is a rich experience in many other countries upon which to draw, both within Europe, Australia and North America, and even within dynamic and forward-looking developing countries such as Jordan and Malaysia..

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APPENDIX 1

List of participants

Name	Workplace
Agnes Hansdóttir	A focus group A teacher in primary school
Allyson Macdonald	University of Iceland Professor
Anna Guðrún Julíusdóttir	The Katla Web http://www.katla-is.net
Arnór Guðmundsson	Ministry of Education Director, Department of Education
Barbra Lindberg	The language studio A teacher in Norwegian
Birgitte Pedersen	The language studio A teacher in Danish
Björg Pétursdóttir	Ministry of Education Specialist
Björn M. Björgvinsson	Laugalækjarskóli Principal
Björn Sigurðsson	Prime Minister's Office Webmaster of the Prime Minister's Office He used to work as a webmaster for The Educational Gateway
Brynhildur Ragnarsdóttir	Laugalækjaskóli, Director The Language Studio
Elísabet Benónýsdóttir	Garðabær Educational advisor in ICT in Hofsstaðaskóli
Elísabet Magnúsdóttir	The focus group for the gateway A teacher in primary school
Erika Trodell	The language studio A teacher in Swedish
Erlendur S. Þorsteinsson	CCP Director of Software Development
Fríða S. Haraldsdóttir	Laugalækjaskóli Director ICT center
Geir Borg	Gagarín Development management
Guðbjörg Sigurðardóttir	Prime Minister's Office, Director General, Department of Information Society, Prime Minister's Office
Guðni Olgeirsson	Ministry of Education, specialist, compulsory education
Guðný Káradóttir	Gagarín Operations manager
Guðríður Skagfjörð Sigurðardóttir	Focus group A and B A Teacher and director in ICT
Guðrún Björg Egilsdóttir	Garðabær Educational advisor in Garðaskóli

Halla Björg Baldursdóttir	Prime Minister's Office, Chair of the eGovernment Task Force, Prime Minister's Office
Hildigunnur Halldórsdóttir	The National Centre for Educational Materials
Hildur Björk Svavarsdóttir	Reykjavik Education Office Head of statistics and research services
Hjörleifur Hjálmarsson	Akureyri Adviser in ICT
Hugo Rasmus	Rasmus A teacher / media production
Ingólfur B. Kristjánsson	The School Web Editor and developer
Jóhann Ísak Pétursson	Rasmus Teacher in MK (college)
Jóhanna Jakobsdóttir	Focus group Discussions / A cases
Jón Páll Haraldsson	Laugalækjarskóli Vice-principal
Jóna Pálsdóttir	Ministry of Education Head of Division, Office of Information and Service
Jökull Sigurðsson	The School Web Operations manager
Kristín Jónsdóttir	Ministry of Education Director, Office of Information and Service
Margrét Sólmundsdóttir	Laugalækjaskóli Director ICT center
Oddný Eyjólfsdóttir	Garðabær Head of school services
Pétur Pétursson	Mentor / Mýs og menn Creator
Samúel Jónasson	Gagarín Software developer
Sari Maarit Cedergren	Focus group Discussions / A cases
Sigrún Sól Ármannsdóttir	The Educational Gateway An ex staff member of HugurAX that did develop the gateway for the ministry.
Sigurbjörg Jóhannesdóttir	Ministry of Education specialist
Sigurjón Mýrdal	Ministry of Education Head of Division
Sigþór Örn Guðmundsson	Reykjavik Education Office Head of statistics and research services
Sólveig Jakobsdóttir	University of Iceland Associate professor, distance learning studies

Stefán Baldursson	Ministry of Education Director, Office of evaluation and analysis
Tomas Rasmus	Rasmus Web designer / teacher / media production
Þorbjörg Þorsteinsdóttir	IceKids developer
Þuríður Jóhannsdóttir	University of Iceland Assistant professor in educational studies