Chapter 7

Digital Media Repository (DMR), iSHARE and Digital Exchange: Lessons from a Digital Content Journey

“We had the idea of a centrally located DMR for all the schools. It was a good concept. The way to go was to create our own content. The main challenge was how to make it user-friendly, or people are not going to use it.”

— Kwek Hiok Chuang, Former Deputy Director, Educational Technology Division (1997–1999)

The Digital Media Repository (DMR) was proposed under the First Masterplan (mp1) as a system to deliver multimedia learning resources such as videos to teachers and students across Singapore from a central repository.

The idea for DMR arose from a pre-Masterplan pilot project called the Students’ and Teachers’ Workbench. Implemented at six Secondary
schools from 1995 to 1996, this project attempted to integrate the teaching and learning environment with multimedia resources using computers in the classroom. It was observed that digital educational resources such as media clips heightened student motivation to learn and supported collaborative work.

Although the DMR pilot project ended in 2002, the vision of a common repository led to the development of iSHARE, a system that allowed school clusters to share digital resources with each other. The resulting growth of school-based networks and portals paved the way for the development of a Digital Exchange, a one-stop resource gateway that would integrate all local educational content and services from schools and the Ministry of Education (MOE) headquarters. In early 2008, edumall 2.0 was adopted as the name for the Digital Exchange.

**OBJECTIVES AND FEATURES OF DMR**

The aim of DMR was to facilitate multimedia resource-based teaching and sharing, leading to more efficient and effective learning. Resources that were available on DMR included video clips, audio files, animated sequences, courseware snippets, CD-ROMs, graphics and photographs. The resources also included user-generated content such as lesson plans or student presentations. DMR resources, whether stored in school repositories, or MOE headquarters, would be accessible from any computer.

The DMR system permitted users to retrieve resources via a search engine with a convenient drag-and-drop interface function. Teachers or students could use the digital content as part of web pages that were hosted within the school or at the central DMR server. Individuals or groups who produced content for DMR could determine whether access rights remained within their school, with other schools in the same cluster or with all schools. There was also a tracking mechanism to monitor the usage of resources.

**DEVELOPMENT CONSIDERATIONS**

When DMR was first conceived in 1998, the sheer scale of network bandwidth requirements for the project led to the consideration of two broad options. One option was to create a single-tier DMR, which would consist of a single repository where all the digital content was stored and
managed. Users would access the resources via a Wide Area Network that linked the central repository to schools. The bandwidth needed for this option was estimated at 34.2 Mbps.

The second option was a double-tier DMR with two groups of repositories: a local repository in each school and a central repository that collected a set of content from the schools’ repositories. The content from the central repository would be cached in the school’s local repository on a scheduled basis during after-school hours using a WAN link with a bandwidth of 2 Mbps.

The double-tier DMR was selected over the single-tier approach as recurrent costs would be lower in the long run. Although the 2-tier DMR would involve a higher initial capital outlay, it was estimated to cost less over a three year period as the single-tier DMR incurred higher annual recurrent costs due to the higher bandwidth requirement. Moreover, Singapore was also anticipating the entry of a second fixed line telecommunications operator, which would mean more market options for high bandwidth network connections in the near future.

In September 2000, the repository was launched in 20 Demo Schools and MOE headquarters as DMR@School. Two remaining Demo Schools joined the system in 2001. The two-tier DMR was implemented in a stepped approach in terms of the number of users and schools, and the bandwidth was to be increased over a period of five years, allowing for yearly review and adjustment. Over the course of the project, MOE invested S$1.7 million to license content at the Primary, Secondary and Junior College levels. Teachers at the schools were able to download content that included approximately 4,000 minutes of licensed video clips and 2,000 minutes of video clips and other resources owned by MOE. These files could be retrieved and incorporated into class presentations.

EXPERIENCE AND EVALUATION

DMR@School was reviewed in September 2001 to assess its effectiveness in enhancing teaching and learning, and determine whether the repository should be extended to all schools. The evaluation revealed that teachers were only using certain parts of the system, such as searching for resources in preparing lessons, and not other capabilities such as student access to resources that formed a sizeable portion of the total operational costs.
One factor that contributed to this usage pattern was the administrative process of accessing resources. While in class, teachers needed to log into the network to access their multimedia resource. When searching video resources, the two-tier system also required the reservation of multimedia resources up to a day in advance for the resource to be downloaded from the central repository to the school’s server. Resources retrieved were also only accessible for a limited time. Due to this access delay and other difficulties encountered in finding suitable resources, teachers found little savings in time for lesson preparation.

There were also a number of physical and technical challenges. In terms of infrastructure, server rooms in schools were not designed to house the additional server that was needed for the system. In addition, remote installation of certain DMR software components on computers did not prove easy as different configurations and specifications in schools made this a complex operation.

After a thorough evaluation, DMR@School was discontinued when the pilot ended in June 2002 as it was not cost effective to maintain a centralised repository for multimedia resources. While relatively simple to use, it lacked suitable resources, particularly for the upper grade levels, which resulted in low usage levels. The high bandwidth required to transfer videos also entailed high annual maintenance costs, and there were additional recurrent costs for upgrading the system for future compatibility. On the operational backend, MOE needed to maintain a team of subject specialists to index the video resources. The DMR thus served as an alternative repository to complement existing resources on the Internet.

With the termination of the project, the digital materials that MOE created for DMR@School was packaged as Digital Learning Resources and compiled onto CD-ROMs for distribution to schools. To help teachers and students quickly locate, preview and retrieve a DLR item, MOE developed a user-friendly Search and Management Application to facilitate a more accurate search.

**IMPACT ON THE LOCAL IT INDUSTRY**

The experience gained from this project lent an insight into the nature of large scale IT systems that MOE would develop in the future. One key insight was that the costs of large scale systems needed to include the
upgrading or enhancement of the system for compatibility with third-party applications and technological advances. Another useful insight concerned how centralised systems needed established development standards to accommodate future changes in MOE’s infrastructure, and the importance of a uniform operating environment for it to work well.

Management of user expectations also emerged as an important learning point as it was simply not cost effective to acquire bandwidth to cater to peak demand; instead, usage had to be optimised across the system. Focussing on the user, systems intended for classroom use needed to be streamlined for curriculum time as processes like logging in were a hindrance. Also significantly, building a stable system required user testing and a trial period in selected schools and this should always precede any full implementation in schools.

The joint development experience with the industry also provided other insights. The DMR system was jointly developed with Singapore Network Services (SNS). There was no other system of its kind in the world when it was conceptualised in 1998. The role of SNS was to develop the system, while MOE sourced for suitable content to populate the system. In terms of its impact, the DMR project served as a catalyst, signaling schools and industry on the importance of the initiative undertaken and triggering further exploration. Local ICT companies such as Daiichi Media and Ednovation soon developed DMR-like systems to deliver multimedia resources in the region. Others like AskNlearn built up in-house teams to develop web-based multimedia resources tailored to the local syllabus. In fact, Ednovation used the experience gained in the DMR project to further develop its School3000 model into SchoolDNA, which addressed most of the problems faced by DMR@School.

MOE’s initial investment translated into cost savings for the schools when the industry moved on to develop better systems on the bandwidth established. In the new eco-system that emerged, schools were able to tap on sources such as the Singapore Totalisator Board grant, eduSave grant and the ICT Masterplan Courseware fund to buy these services. Competition forced the vendors to keep up with technological advances and enhance their systems and the services provided to schools in order to attract and retain their customers.

The DMR pilot project also helped to seed the education software industry in Singapore. Local vendors had developed considerable
expertise working with MOE on various content development projects and were even starting to market software products in places like China. A major provider that offered the promise of breaking into the US market was Times Publishing Pte Ltd. The domestic market for education software was relatively small, with school expenditure amounting to S$10 million a year. However Singapore was useful as a test-bed to develop software for larger markets overseas.

The concept of DMR was a good one, but the conclusion from the pilot project was that MOE should not provide the content and infrastructure backbone. A better way was to let schools drive this effort and work out commercial arrangements with vendors. In such arrangements, schools would need to put in a server, costing S$6,000 to S$8,000, while MOE would provide a bandwidth of 2 Megabytes.

As for content, users wanted pedagogical input on the resources to jumpstart their use and reflect the way a teacher planned his or her lesson as they had not found resources in raw form very useful. Consequently, ETD began to organise all digital content according to the syllabi and include suggestions on how to use the resources with lesson packages incorporating the resources. MOE also went on to explore a cluster-based server as an infrastructure for sharing, leading to the innovation of iSHARE.

**iSHARE: BACKGROUND AND DEVELOPMENT**

By 2004 school clusters were showing the need to establish shared repositories for digital resources. The natural evolution of the landscape pointed towards multiple repositories of digital content managed by different schools, clusters or zones. Though clusters had explored repository solutions to tap the potential of resource sharing between schools, the practice was hindered by the lack of inter-connectivity across different systems that were utilised by schools and clusters. The various school clusters moved at different pace, where some had gone ahead to develop a cluster-based repository, while other schools were starting to explore similar areas.

In May 2004, a Digital Content Management Framework (DCMF) to manage digital content was also in motion. Such a framework was seen
as essential to facilitate the sharing of quality digital resources between schools for teaching and learning. The focus was on increasing the awareness and proficiency levels of teachers in digital content development to address the concerns of an unmanaged growth of resources: increasing disorganisation, wide variations in quality and issues of intellectual property.

DCMF aimed to facilitate the sharing of digital resources by providing an interoperable infrastructure and consistent governance structure. It was designed to support systematic content development, encourage greater integration of ICT in teaching and capture the wealth of intellectual assets and experience that was being generated by curriculum experts, teachers and students. The framework was to be easy-to-use, scalable, sustainable in terms of cost and resource utilisation, and aligned with the policy of school ownership and autonomy emphasised in mp2.

Proof-of-Concept

The first sharing framework to emerge (see Fig. 1) was called iSHARE (inter-cluster SHAring of REsources) framework. It was adopted in May 2005 where a Proof-of-Concept (POC) project was started which involved three clusters in the West Zone with a total of 33 schools. iSHARE

![iSHARE Framework Diagram](image-url)

**Figure 1:** iSHARE Framework
differed from DMR as it provided users with access to digital resources via the Internet rather than an internal server network. Interoperability was established so that resources could be transmitted across various delivery platforms. The management of resources was decentralised, so resources were distributed across multiple repositories. Users accessed the resources on an iSHARE portal with common functions such as user login, personalisation and administration.

Interoperability with other external repositories has been an important feature of the iSHARE platform. Searching for resources across different repositories has been made seamless using a standards-based search engine called the Global Search Index (GSI) optimised for finding and retrieving materials based on a common set of search terms metadata standards which refer to information or keywords that describe the context, content and structure of data. This standardisation was vital to make the platform scalable for future expansion to other clusters and zones.

Expansion of iSHARE

By December 2005, iSHARE was populated by about 10,000 digital resources shared between three clusters. The POC’s target of 10% of teachers contributing within a cluster was exceeded, with up to 60% of teachers contributing in one of the clusters. Resource utilisation also rose significantly over the POC period. One cluster received a total of 46,000 hits, with more than 50% of teachers accessing and utilising the repository. Cross-cluster resources utilisation was also apparent.

Findings from teacher surveys indicated that iSHARE had met its objective of establishing interoperability across the different clusters. Crucially, teachers responded that the search feature and interface was user friendly with more than 80% of teachers able to locate relevant resources and share resources easily within and across clusters. In addition, more than 90% of teachers felt that iSHARE should be extended to other clusters to encourage greater sharing of resources.

After the POC pilot, MOE began to expand the iSHARE framework to all school zones. Each school cluster was given the autonomy to
subscribe to any vendor-provided repository solution as long as connectivity and interoperability with other clusters were maintained. By June 2008, there were about 66,000 listed resources in iSHARE, with teachers contributing many quality lesson packages. The iSHARE project attained its key goal of enabling schools to seamlessly share digital resources within and across clusters. In addition, the iSHARE framework provided schools with a systematic and formalised deployment model to implement cluster and zonal repository solutions that were interoperable with each other, and thus set the stage for collaboration at the next level in a Digital Exchange (DE).

THE NEW edu.MALL: A CONVERGENCE IN PROGRESS

With the background of various digital content initiatives over the years ranging from MOE created content in Digital Media Repository (DMR), Rich Digital Media Content (RDMC) and edu.MALL to cluster-based resources through iSHARE, the logical evolution for educational content delivery in MOE is for even deeper and more extensive integration. Beyond edu.MALL and iSHARE are educational resources that reside on different websites hosted by different institutions like the National Library Board (NLB) or on standalone CDs that can finally be brought together in one place: a new Digital Exchange (DE).

As a key component of IDA’s iN2015 vision of a Singapore-wide Learning Digital Exchange (LDX) to support education and learning, a Digital Exchange would support the sharing and exchange of a wide variety of interactive digital learning resources between the educational community as well as the public and commercial content providers.

As an Internet-based portal, DE will host all MOE headquarters teaching and learning digital resources, thereby offering economies of scale in resource management and better quality control. By gathering trusted resources from various content developers and offering interactive services, DE is poised to nurture online learning communities and greater collaboration between educators and learners. In DE, the technology gap between vision and reality would be bridged and the themes of multimedia content creation, sharing and delivery return almost full circle to the original ideas that began with DMR.
Figure 2: Relationship between edumall 2.0 and other sources of digital resources
Figure 2: (Continued)
In the interest of recognition and continuity, the Digital Exchange was named edumall 2.0, a name all Singapore schools were already familiar with.

ENDNOTES

1. Administratively, Singapore’s schools are grouped into four geographical zones: North, South, East and West. Within each zone are clusters comprising 10–15 schools each.

2. Singapore Totaliser Board is a statutory board under the Ministry of Finance. Since 1 May 2004, it owns Singapore Pools which is the only legal lottery operator in Singapore to provide a legal avenue for betting in Singapore.

3. In 1993, the Government started the Edusave Scheme to maximise opportunities for all Singaporean children. The Scheme rewards students who perform well or who make good progress in their academic work or co-curricular activities, and provides students and schools with funds to pay for enrichment programmes or to purchase additional resources.
