Opportunities and constraints for development and translation of digital learning resources

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1. Abstract

Translatability is in itself a limited technical aspect of learning resources, but it is very closely related to other technical aspects that impede the portability of learning resources. This study is about how to think and reason as an originator and a producer of digital learning resources, when the purpose is to produce material that from a technical point of view also can be used by users outside the primary target group.

The study also placed the technical portability in a larger context, based on ideas about how digital learning resources should function in order to provide optimal use.

2. Assignment

The assignment from The Swedish National Agency for Education was to make a pre-study about the opportunities and difficulties that arise when digital learning resources are translated from foreign languages.

It was suggested that the pre-study should be based upon specific examples from the service Learning Resource Exchange for Schools at the EUN (European Schoolnet).

The pre-study should primarily focus on examples from the Natural Sciences.

The assignment includes:

- A description of different types of learning resources from a technical point of view.
- Translation of an appropriate number of resources and a calculation of the average time required for translation.
- A description of the characteristics of resources that are easy or difficult to translate.

The Learning Resource Exchange service for schools was officially launched by European Schoolnet on 1 December 2008 initially offering nearly 120,000 learning resources and assets from over 20 repositories in the LRE federation. In a first phase, the public LRE service is particularly being promoted to schools in the European Commission's eTwinning initiative before a full opening to the entire school community in 2009. Visit: http://lreforschools.eun.org.

Contacts at the The Swedish National Agency for Education:

Christina Szekely, Peter Karlberg and Alma Taawo.

3. Assignment development

Shortly after the commencement of the pre-study, it became obvious that the opportunities and constraints that arise when a learning resource is translated, are closely related or nearly identical to the technical properties of the file formats being used.

The technical properties determine if the resource can be manipulated, developed, recycled, copied, downloaded, etc. Therefore we decided to examine the importance of the file format when trying to make learning resources usable with as few built-in obstacles as possible.

This modified approach was accepted by the The Swedish National Agency for Education.

4. Study

4.1 Introduction

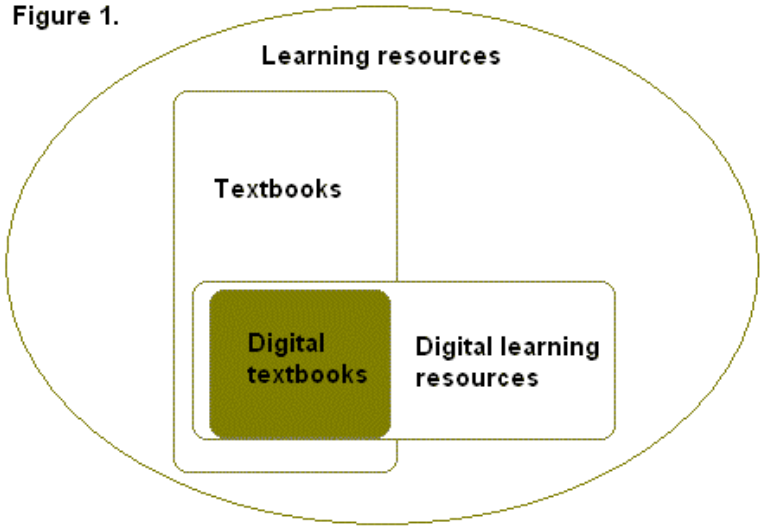
As digital technology continues to develop and spread to all parts of society, there is also an increasing interest for digital learning resources in the educational sector.

In parallel with this, there are two ongoing debates concerning digital learning resources. One debate focus on the pedagogical usefulness, and the other one is discussing what a digital learning resource actually is.

This study implies that digital learning resources already are very valuable from a pedagogical point of view. They add interactivity, moving images, new forms of communication and other things that are beneficial to education. However, in this early stage of development there is still much to be desired, both at the pedagogical level and from the infrastructure that is required for easy access and effective handling.

In the debate about what constitutes a digital learning resource, this image shows, in a simple and pragmatic way, how they relate to other concepts in this field.

Figure 1. (Note 1.) Concept map of teaching and learning resources



The study begins with a presentation and an explanation of two concepts: interoperability and good portability of learning resources. These concepts are central for the understanding of the role of the technical format in the discussion about the portability and translatability of learning resources.

The conceptual basis for the discussion about digital learning resources is that they, as far as possible, should be open, i. e. they should be made by open software using open technical formats, and downloading and copying should be allowed. The metadata should be described by using generally accepted standards, and they should also be downloadable. If there are any constraints, e.g. copyright or technical formats, this should be explained explicitly, preferably in a standardized, machine-readable manner.

This approach is rooted in several traditions; the academic idea of open access, ideas of digital commons derived from common rights, the open source movement and from the standpoint that everything that is financed by taxpayers should be freely accessible for all.

Moreover, public schools save money if digital learning resources can be developed and shared freely.

BECTA (British Educational Communications and Technology Agency) is one example of an organization that has a similar perspective on digital learning resources. See e.g. Promoting an ecosystem that enables the discovery, delivery and sharing of digital learning resources. Note 2.

This study is meant to be a survey and a tool regarding technical formats for producers and customers of digital learning resources, in order to help them understand the possible consequences of a chosen format. It is aimed at everyone interested in digital learning resources and requires a basic understanding of internet/web technology.

Accessibility for the disabled is an important issue related to digital learning resources, but it requires its own study and recommendations and is only dealt with summarily here.

There are several synonyms for the term digital learning resource: learning object, digital learning object, learning module, etc. This study will use the terms digital learning resource or learning resource.

4.2 Method

This study makes a review of the most common technical formats used in learning resources, based on the concepts interoperability and good portability. These concepts help to describe the problems with the technical formats and put them into a context.

The study presents and describes briefly some resources from LRE and other archives. Finally, it concludes with some recommendations.

4.3 Two concepts

Interoperability and good portability are two concepts that can be used as a map over the context the technical formats can be placed in. Both concepts describe the factors that are the basis for the ease of use and the flexibility of the learning resources outside of their original environments.

4.3.1 Interoperability

Interoperability is *the ability of different systems and organisations* to work together. Usually, this refer to how well different IT systems can cooperate and handle each others' content.

We tend to talk about two kinds of **interoperability**: syntactic and semantic.

Syntactic interoperability means that two systems can communicate and exchange data through specified data formats and and communication protocols. XML and SQL standards are two examples.

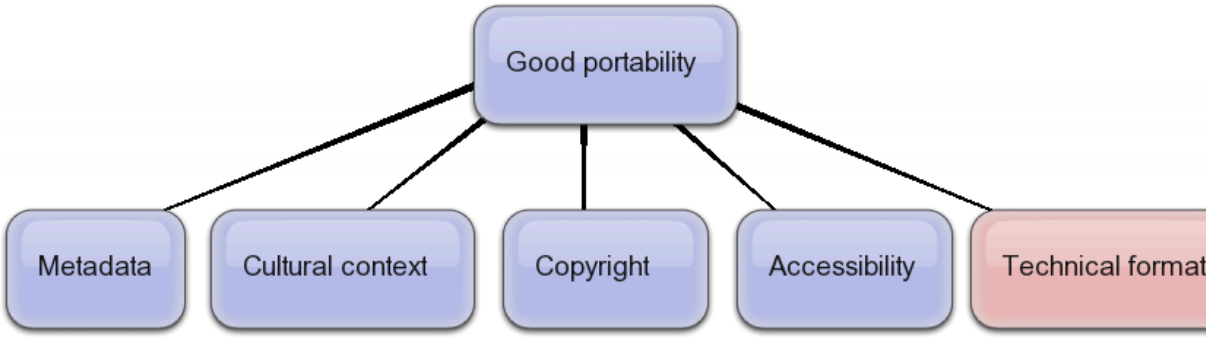
Semantic interoperability is built on the premise that the syntactic interoperability works, and take it one step further by making systems interpret the exchanged information in a meaningful and unambiguous way. This means that the end-user can be certain to receive the intended information.

The concept **cultural interoperability** is not related to IT systems, but concerns the extent to which the content expressed in a learning resource is being accepted by users outside its original context.

4.3.2 Good portability

Good portability is a conceptualization of the concept **travel well**, launched by Riina Vuorikari at EUN, aimed at cross-lingual and cultural interoperability. (Note 3). The cultural context is a part of the concept **good portability**, together with metadata, copyright, accessibility and technical format. This makes good portability an overall concept, covering the aspects that make it easy or difficult to use learning resources outside of their original context.

Good portability can be considered as cultural interoperability in the broad sense of the term, applied on digital learning resources.



Metadata: Separation between data and metadata, downloadable, metadata standard, connection to steering document.

Cultural context: Connection to curriculum, navigation, symbols, images.

Copyright: Terms of use, information about copyright status, copyright status presented in a standardized format.

Accessibility: How well a learning resource can be used by disabled people.

Technical format: File format, downloadable, information about technical portability and potential for further development, translatable.

4.3.3 Comments about metadata

There is a separate box above for metadata. The term primarily refers to traditional metadata: identification number, title, description, target group, subject, etc. Development of metadata is taking place in areas like annotation, context and meta-analysis of metadata (e.g. meta tag analysis).

However, it must be noted that there is metadata for the other boxes as well. There are also efforts for standardization in these fields, but it is not as developed as in the area of traditional metadata.

4.4. Technical formats: Frequency, description and portability

Digital learning resources are produced in many different technical formats. This is partly because they can consist of different forms of media, and partly because they occur in competing technical solutions.

Every form of media can be connected to administrative data and communication systems as mail, instant messaging and conference systems, and be presented on websites that consist of many objects.

4.4.1 Website

A website is probably the most common presentation format for a learning object. A web page is also the natural way to present learning resources that are composed by several different objects.

A website is a coherent collection of texts, documents, images and multimedia that can be reached on the World Wide Web, i.e. through communication over the Internet using HTTP.

Pure HTML pages are easy to transfer to other environments and HTML code is easy to edit. However, only a few web pages consists of just text and images. Most web pages contains embedded objects such as video, stylesheets, scripting language, Flash applications and applets.

The text of a web page can be easily translated or modified in the HTML code, but embedded objects must be editable if they are to be changed.

Examples:

Web page in HTML without object, note 4

Web page in HTML with different objects, note 5

4.4.2. Flash

Flash is a common and popular format both among producers and consumers of learning objects. It is appreciated for its ease of use, flexibility, speed and low use of memory.

Flash is a multimedia platform that is being used to produce and present animation and interactivity on web pages. Flash Player, which is downloadable for free, is needed to play Flash files.

A Flash file is made by FLA files, animations, applets and Flash video that are compiled to a SWF file and played on the user's computer. Depending on the permissions set by the creator, the SWF file can either be played from a website or be downloaded.

SWF files are difficult to edit because there is no support for this in Flash Player. There are SWF decompilers, but they are not of much use without the original files. This means that Flash files are difficult to translate and transform.

Example:

Måle motstand, note 6.

4.4.3 SVG

Scalable Vector Graphics, SVG, is a language for describing scalable two-dimensional vector graphics and animations. The technology is developed by the World Wide Web Consortium, and it is an open format that by some is regarded as a future competitor to

Flash. Even though it is not yet as widely supported, it is appropriate for learning resources because of the good portability.

Example:

Att dela med sig av det man skapar, note 7

4.4.4. Java

Java applications are commonly used as learning resources. In recent years, its importance has been reduced in comparison with Flash. Java is mostly used when more advanced programming is needed, while Flash is more design-oriented.

Java is platform independent and a java application can be run on all computers regardless of the operating system. The platform independency makes it especially suitable for web applications and networks. Java applications (applets) are often distributed as a packet file. They can be downloaded or be run in most web browsers using a Java Virtual Machine.

The portability depends on how the programming was done and how it is presented. Text and images are usually easy to transfer and when programmers are being tasked to follow good programming habits, there is rarely any trouble. The problem is rather that existing objects, including learning resources, in most cases were not designed with portability in mind.

Example:

Balloons and Buoyancy, note 8.

4.4.5. PDF

PDF is a common format for document management and for text-based learning resources. It is primarily used as a distribution format, both for on-screen display and for printing. Since a PDF file look the same on screen and print, the format is often used as the basis for printing.

It is an open format, which means that anyone can make software to create PDF files. The format is supported on several platforms and operating systems. An increasing number of software applications include built-in PDF export function, for example OpenOffice and Microsoft Word. The most common reader is Adobe Reader, which is available without charge. There are also several free software alternatives.

PDF is mainly used to lock a document and to make it unchangeable. This means that PDF documents are difficult to edit and develop. There are software applications that enables editing of PDF documents, but it doesn't always work.

Example:

The burnt hand, note 9.

4.4.6 Office

Most computers come with an office suite and Microsoft Office is the most common. There is no full compatibility, but documents can usually be saved in a file format that all suites can read.

The most common applications in an office suite are wordprocessing, calculus and presentation. OpenOffice.org (OpenOffice.org), iWork (Apple) and Star Office (Sun) are examples of three well-known office suites.

There is a high level of portability because files are easily downloaded, reworked and developed. Office suites are general purpose software that are easy to use. When more advanced functionality is needed, it is better to use specialized software.

Example:

http://dum.rvp.cz/materialy/stahnout.html?s=uztbzeik

4.4.7 Video

Video has been available on the Web for more than a decade and made its breakthrough when Youtube was launched. Since then it has had an exponential growth and is increasingly being used for digital learning resources.

It is necessary to make a distinction between video compression formats and video container formats.

There are a number of compression formats for audio and video data, e.g Multimedia compression formats, note 11.

The compressed audio and video files are parts of a so-called container format. This is a file that contains video, audio, subtexts and different kinds of metadata, for example chapter information. It is the container format that is visible in a computer's directory. For a comparison between different formats, see Comparison of container formats, note 12.

The most common video container formats are Flash, Windows Media, Quick Time and Real.

MPEG-4 is a video compression format and an ISO standard that has many proponents. It is supported by QuickTime Player, Flash Player, Real Player and the most recent version of Windows Media Player (WMP 12).

The increased use of embedded video on the Web has made Flash one of the most commonly used video container formats. Flash Player is required to watch Flash video. Both Flash graphics and Flash video are very popular because of their speed and flexibility.

However, the portability is not as good. Further development is difficult and the format does not have built-in support for subtitles.

Windows Media, QuickTime and Real are other common formats, even though the popularity of Real is on decline. Files using these formats are easier to develop and there is built-in support for subtitles.

Good portability for video learning resources requires:

- Editable audio and video.
- Support for editable subtitles.
- Editable metadata included in the file.
- The ability to tag and refer to sections and chapters with metadata.

Access to the source files in high definition audio and high resolution video or compressed formats like MPEG2 and AC3 facilitate further development.

Example:

Introduction to the Class, note 13

4.4.8 Interactive whiteboards

An interactive whiteboard consists of a large interactive screen connected to one or more computers. The screen is pressure sensitive and can both be used as an ordinary whiteboard or as an interactive computer screen.

Interactive whiteboards are about to be widely distributed throughout the education system, and are also being used by private companies, organizations and government agencies. Smart Board and ActivBoard are the dominant suppliers in Sweden.

The use of proprietary file formats prevents collaboration and sharing of learning resources, both within and between schools.

Becta has presented a technical specification common file format for interactive whiteboards that will be supported by the major manufacturers, European Schoolnet and European governments and organizations.

Smart Board provide free software that makes it possible to view content created with a Smart Board. Note 14. Example resources are available at Lektion.se. Note 15.

4.5 Formats and portability

- Every technical format is structured according to its own starting points and conditions. One way to approach the different formats, is to investigate these areas:
- Are the resources simple or composed?
- Is it open format and open source software or are the resources based on proprietary code?
- Accessibility for people with disabilities.
- Are they composed of simple files, packet files or compiled (compound) files?
- Is the resource a website that contains many different file formats?
- Are the source files accessible for editing?

Learning resources tend to become increasingly complicated in structure. Web 2.0 pages are made up of objects that are on other servers than the one where the learning resource is hosted.

Higher levels of portability can be achieved when good programming habits are followed and content and logic is separated. Textual content should be put in separate files that can easily be edited or translated without changing the logic.

It is not likely that producers of learning resources deliberately choose difficult file formats. Bad portability usually occurs because producers prioritize the needs of their primary users. For example, accessibility for disabled users is often forgotten or not given sufficient attention.

Sometimes the request for good portability is impeded by copyright restrictions. Even if there are agreements that regulate remuneration, intellectual property rights can be used obstructively. It's far from certain that authors allow free modification of their work. Nor can one assume that it's possible to refer directly to sections and chapters of a work without infringing the author's moral rights.

4.6 Accessibility

Accessibility is briefly defined as how well a learning resource has been designed to meet the needs of all users, including those with disabilities.

Just as with a physical environment and the web in general, there are obstacles and challenges that can make it difficult for people with disabilities to use digital learning resources.

WAI (Web Accessibility Initiative) is run by World Wide Web Consortium (W3C) with the purpose to improve accessibility for all on the web. WCAG (The Web Content Accessibility Guidelines) is a working group within WAI that create and provide guidelines for the development of accessible web content. It can be any kind of information available on the web: text, images, audio, video and so on. See note 16.

The technical characteristics of a file format is an important factor affecting accessibility. See note 17 for a description of how Flash works in this respect.

Questions regarding the usability of different technical formats for optimization of accessibility demand their own study, and are important to consider for both purchasers and producers.

4.7 Translation costs

Every archive and resource about to be translated need to be studied separately. It is difficult to draw any general conclusions about the sum of technical and language-related costs, but here are some starting points.

4.7.1 Technical costs

If an archive is about to be translated, the following steps are appropriate when calculating the technical costs:

- Take a sample resource in order to assess the frequency of the different types of formats in an archive.
- Make test translations that help you get an idea of the time needed for each format.
- Estimate the cost of development and programming.
- Calculate total costs based on the frequency of different formats and the time required for translation.

4.7.2 Language-related costs

The resources in LRE are available in many languages and must be translated in order to be usable in Swedish education. The costs for translation may depend on:

- How many people speak the language?
- How many translators are available?
- How difficult is the subject?
- How much work is required?
- Since there are no fixed prices for translation services, the price has to be negotiated with each translator.

5. A review of some archives

In the appendix, there is a review of a couple of learning resources from LRE and some other archives. They have been chosen because they are typical examples of learning resources in common technical formats, that can be found in various archives and on the web. Some resources are pedagogically simple and others are pedagogically complex.

6. Conclusions and recommendations

The technical format is one of the key conditions to make learning resources usable outside of their original environment.

Digital learning resources are always produced for a specific purpose and in a particular context. Hence, there are often good explanations for the lack of portability. The main reason is usually that the learning resources were produced for the needs of a primary target group and were not originally intended to be a part of an archive.

The principles of good portability has not been marketed or discussed beyond the small groups of researchers and officials working with ICT development in education.

Many of the popular file formats are far from optimal from the perspective of good portability. These file formats are often being used because they are simple to use, memory efficient, fast and generally accepted among the primary users. But, the principles of good transferability can also encourage and increase use of the learning resources. If, for instance, a publisher aims to create resources that can be easily translated into other languages, there is an increased possibility that foreign actors become interested.

6.2 Recommendations

The most important recommendation for both purchasers and producers of learning resources is to start to reflect on the need for portability. Just by doing so, a door is opened for further thoughts.

These are the basic questions about choice of technology for portability:

- Who will use the learning resources?
- Are there any additional groups beyond the primary users?
- How is the ICT environment organized?
- How do we handle accessibility for disabled users?
- Are we using the optimal file formats or are we working by routine?
- Are we using open source software and open file formats?
- Is it possible to make the source files available?
- If no source files are being available, can we tell the users how the textual content is made accessible (e.g. readme files)?
- Is it possible to describe the technical portability by using some metadata standard?
- Did we follow good programming habits when we created the learning resources?
- How does the technical structure of a learning resource look like? Is it built modularly, with small, independent objects or is it built into a unified whole?
- Should it be possible to download, translate and develop the resource?

- Is form, design and portability more important than the level of portability?

Some further recommendations:

- Responsible authorities should develop, publish and distribute information about the significance of technical formats when creating digital learning resources.
- Standardization efforts should be supported.

7. Notes

1. Source: Jan Hylén, Metamatrix

2. BECTA: Promoting an ecosystem that enables the discovery, delivery and sharing of digital learning resources, http://industry.becta.org.uk/display.cfm?resID=40418&page=1713&catID=1621

3. Riina Vuorikari: Exploratory Analysis of the Main Characteristics of Tags and Tagging of Educational Resources in a Multi-lingual Context, http://journals.tdl.org/jodi/article/view/447/284

4. Web page in HTML without object, http://test.scoilnet.ie/Res/hanpat0503002248433_2.htm

5. Web page in HTML with diferent objects, http://openlearn.open.ac.uk/course/view.php?name=M208_3

6. Måle motstand, http://celebrate.ls.no//Norsk/Animasjoner/NMfag/Male_ohmXL.swf

7. Att dela med sig av det man skapar, http://kollakallan.skolverket.se/upphovsratt/creativecommons/attdela/

8. Balloons and Buoyancy, http://phet.colorado.edu/simulations/sims.php?sim=Balloons_and_Buoyancy

9. The burnt hand, http://dev.ecweb.is/skolavefurinn/upload/files/attachments/enska/hofundar/guerber/26_chapter_text.pdf

10. Pracovn' list k učivu Molekuly a chemickeꝰL sloučeniny, http://dum.rvp.cz/materialy/stahnout.html?s=uztbzeik

11. Multimedia compression formats, http://en.wikipedia.org/wiki/AMV_video_format

12. Comparison of container formats, http://en.wikipedia.org/wiki/Comparison_of_container_formats

13. Introduction to the Class, http://mfile.akamai.com/7870/rm/mitstorage.download.akamai.com/7870/8/8.224/s03/etaylor-8.224-sem-mit-9151-06feb2003-1430-220k.rm

14. Notebook interactive viewer, http://www2.smarttech.com/st/en-US/Support/Downloads/Notebook+IV/

15. Lektion.se, http://www.lektion.se/

16. Webb - tillgänglighet – funktionshinder, http://www.w3c.se/resources/office/talks/20020417/wai-print.html

17. How to make your Flash Content accessible and WCAG 2.0 compliant, http://accessibility.mitsue.co.jp/resources/csun2009/

Appendix

22 examples of learning resources

#	Title/Archive	Subject/URL	Language	Media type	Technical format	Degree o complexi
1	Måle motstand /EU	Physics http://celebrate.ls.no//Norsk/Animasjoner/NMfag/Male_ohmXL.swf	Norwegian	Interactivity	Flash	Simple
2	Øyet - fokuseringsfeil /EUN	Biology http://celebrate.ls.no/Norsk/Animasjoner/NMfag/linser_fokuseringsfeil.swf	Norwegian	Interactivity	Flash	Simple
3	Geogebra /Geogebra	Mathematics http://www.geogebra.org/cms/index.php?lang=no	Many	Interactivity	HTML, Java	Advanced
4	Trekant /EUN	Mathematics http://celebrate.ls.no/norsk/animasjoner/matematikk/trekant/index.html	Norwegian	Interactivity	Java	Simple
5	Faktorisering /EUN	Mathematics http://celebrate.ls.no/norsk/animasjoner/matematikk/faktor/index.html	Norwegian	Interactivity	Java	Simple
6	The Story of the Romans, chapter 26 /EUN	History http://dev.ecweb.is/skolavefurinn/upload/files/attachments/enska/hofundar/guerber/26_chapter_text.pdf http://dev.ecweb.is/skolavefurinn/upload/files/attachments/enska/hofundar/guerber/26_chapter_text.pdf	English	Text	PDF	Simple
7	The Story of	History	English	Text	PDF	Simple

	the Romans, chapter 22 /EUN	http://dev.ecweb.is/skolavefurinn/last/?ec_item_0_id=8e5f9d7abb7b4982abcca2183e42734d&searchparam1=name=The%20Story%20of%20the%20Romans				
8	A háromszög súlyvonalai /EUN	Mathematics http://sdt.sulinet.hu/Player/default.aspx?g=030ffe2670b04ba39f7f3916b6be0db8&cid=9d9d8e05cab54d71b3d88df1cea56114http://www.oki.hu/oldal.php?tipus=cikk&kod=linkActivities	Hungarian	Interactivity	HTML, Java	Advanced

#	Title/Archive	Subject/URL	Language	Media type	Technical format	Degree o complexi
9	Symmetry /EUN	Mathematics http://openlearn.open.ac.uk/course/view.php?name=M208_3 http://openlearn.open.ac.uk/course/view.php?name=M208_3	English	Text	HTML, Java, Flash	Advanced
10	Balloons and Buoyancy /U of Colorado	Physics http://phet.colorado.edu/simulations/sims.phpsim=Balloons_and_Buoyancyhttp://phet.colorado.edu/simulations/sims.phpsim=Balloons_and_Buoyancy	English	Interactivity	Java	Advanced
11	Cancer Biology: From Basic Research to the Clinic, Fall 2004 /EUN (MIT)	Biology http://ocw.EUN (MIT).edu/OcwWeb/Biology/7342Fall2004/CourseHome/index.htmhttp://ocw.EUN (MIT).edu/OcwWeb/Biology/7342Fall2004/CourseHome/index.htm	English	Text, images, video	HTML, PDF	Advanced

12	Software Engineering for Web Applications /EUN (MIT)	Computer Science http://ocw.EUN (MIT).edu/OcwWeb/ ElectricalEngineerin gandComputerScien ce/6171Fall2003/Co urseHome/index.htm http://ocw.EUN (MIT).edu/OcwWeb/ ElectricalEngineerin gandComputerScien ce/6171Fall2003/Co urseHome/index.htm	English	Text, images	HTML, PDF	Advanced
13	Topics in Computational and Systems Biology /EUN (MIT)	Biology http://ocw.EUN (MIT).edu/OcWeb/Bi ology/789Fall2007/C ourseHome/index.ht mhttp://ocw.EUN (MIT).edu/OcWeb/Bi ology/789Fall2007/C ourseHome/index.ht m	English	Text, images	HTML, PDF	Advanced
14	Basic Ideas on the Periodic Table /EUN	Chemistry http://test.scoilnet.ie/ Res/hanpat0503002 248434_2.htmhttp://t est.scoilnet.ie/Res/h anpat050300224843 4_2.htm	English	Text, images	HTML	Simple
15	Mole's Law, Avogadros Law and Avogadros Number /EUN	Chemistry http://test.scoilnet.ie/ Res/hanpat0503002 248433_2.htmhttp://t est.scoilnet.ie/Res/h anpat050300224843 3_2.htm	English	Text, images	HTML	Simple
16	Organická chemie /EUN	Chemistry http://dum.rvp.cz/ma terialy/stahnout.html s=wdzivxryhttp://du m.rvp.cz/materialy/st ahnout.htmls=wdzivx ry	Czech	Text	Word	Simple
17	Molekuly a chemicke sloučeniny /EUN	Chemistry http://dum.rvp.cz/ma terialy/molekulyache mickeslouceniny.htm lhttp://dum.rvp.cz/ma	Czech	Text, images	Power Point	Simple

		terialy/molekulyachemickesklouceniny.html				

#	Title/Archive	Subject/URL	Language	Media type	Technical format	Degree o complexi
18	Smesi /EUN	Chemistry http://dum.rvp.cz/materialy/stahnout.html?s=zezsqrbhhttp://dum.rvp.cz/materialy/stahnout.html?s=zezsqrbh	Czech	Text, images	Power Point	Simple
19	Kemisk bindning, organisk kemi (Modul 2 – Kemi A) /EUN	Chemistry http://melt.contento.se/broker/pages/loader.aspx?objectid=13422http://melt.contento.se/broker/pages/loader.aspx?objectid=13422#	Swedish	Text, images, animations	HTML	Simple
20	Producing salts from direct combination of metals with other elements /EUN	Chemistry http://melt.cup.cam.ac.uk/DataServlet/79700.jpghttp://melt.cup.cam.ac.uk/DataServlet/79700.jpg	English	Image	JPG	Simple
21	Exploring Black Holes: General Relativity & Astrophysics /EUN (MIT)	Physics http://ocw.EUN (MIT).edu/OcwWeb/Physics/8-224Exploring-Black-Holes--General-Relativity---AstrophysicsSpring2003/CourseHome/http://ocw.EUN (MIT).edu/OcwWeb/Physics/8-224Exploring-Black-Holes--General-Relativity-	English	Text, images, video	HTML, PDF, Real Video	Advanced

		-- AstrophysicsSpring2003/CourseHome/				
22	Secret Worlds: The Universe Within /EUN (FSU)	Physics http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/	English	Animation	HTML, Java	Simple