

Content:	Page
Design Concepts:	Pg 2
• 1.1 Graphic Design	
• 1.2 Dealing with Disabilities	
• 1.3 Content Templates / Information Design	
Evaluation:	Pg 4
• 2.1 Evaluation One	
• 2.2 Evaluation Two	
• 2.3 Finalised Design Evaluation	
Content Author Usage:	Pg 5
Technical Concepts:	Pg 6
• 3.1 Code design	
• 3.2 Browser Compatibility	
• 3.3 Known Browser Bugs and Compatibility Issues	
• 3.4 Platform	
• 3.5 Specifications	
• 3.6 Accessibility and Technical Issues	
• 3.7 Download Time and Audio Media	
• 3.8 Personalisation	
Conclusion:	Pg 9
Appendices:	Pg 10
• Netscape 6+ print bug screen information and URL Reference	Appendix i
• Appendix ii – Table of Image Resources	Appendix ii

Design Concepts

After lengthy discussions on interoperability, it was decided that web based technology should be used when designing the project. HTML and JavaScript coding was chosen as the technical basis for the project, as this captured the largest audience and platform framework.

The visual design of the objects went through various degrees of evolution during the course of the project. There were four main influences steering the visual / aesthetics of the project. These included:

- Graphic design influences
- Disability principles
- Evaluation
- Technological restraints

1.1 Graphic Design

It was decided in advance of the project start date, that the design would support and not hinder the delivery of the learning objects content. All visual aspects would frame the objects content rather than encroach upon content areas, so visual aspects become appealing to the eye, but have definite boundaries.

After evaluating some designs from our own bank of CD-ROMs and resources we found that designs that flowed into content areas were distracting. This was also a shared opinion that was received from various user-testing sessions carried out by students, reinforcing our own conclusions.

Feedback from lecturing staff suggested that the over indulgence in rich visual media, such as images and animations that were not directly subject relevant, served as distracters. These potential distracters were seen as having an adverse effect on the learner's intake of information, generating learning barriers, especially for those with attention disorders.

So armed with these observations work began on the first draft of what was termed the 'Object Viewer'.

(See Technical Concepts).

Graphical changes were made to the aesthetics of the object container up until the finalised version. These changes were driven mainly by user feedback derived from post evaluation sessions. Final design changes (project polishing) were driven purely by technical and functional specifications.

1.2 Dealing with Disabilities

From the start we knew that user operability issues were not just confined to technological issues, some of the major leaps forward we made during the project, with regards to delivering these objects, were in relation to instructional / technical design. However as past experience had taught us, the actual visual / aural delivery of the content, was equally important.

Some examples of visual operability design thinking can be seen in the following statements.

The Arial font was chosen for its clarity and universality (on a user and technological basis), the font sizes were also made relative so to allow users to change the font size. The layout was also designed in such a way that users are able to make these changes without considerable alterations being made to visual alignments.

(See the Evaluation section of this document for incremental design change)

The colours / patterns used do not flow into the content areas. A pure white background with black text was chosen as to meet the needs of the widest possible audience framework, maintaining a good contrast between background and text.

All display information is CSS based, allowing display changes to be made if necessary. In addition, all images other than content images are of low saturation and are easy on the eye.

As mentioned in the previous section, final design changes were focused on functional / technological aspects. In the final phase of the design, all tabular layouts were removed and replaced by CSS layouts. Additionally, as an optional failsafe for those who do not wish to read from the screen, all pages were made print friendly using separate CSS stylesheet configurations. **(See Technical Concepts)**

1.3 Content Templates / Information Design

Before mentioning the evaluation process and the effect it had on the design, it is worth noting that after the initial design concept arose, work started not on the object production, but on the concept of information design.

It became apparent in the first few meetings that it would take some time to get the right balance between the design and technical aspects. Failure to accommodate this balance would have inevitably resulted in authors trying to introduce content into ill-fitting containers. So a fluid information design flow was developed, allowing the technical / design aspects to run parallel to the content development.

Giving the content authors a free reign would have resulted in inconsistent material that would require too many technical / design alterations to accommodate them, so some parameters were set up. This was done via word templates. We looked at existing assessment material already on the market and decided to generate word templates based on the most popular and generic to fit the content. The list was as follows:

- Multiple Choice
- Gapped Sentence
- Image Sequence
- Numeric Input
- Sentence Builder
- Drag and Drop

The templates themselves went through two design changes but the content from the first was fully transferable into the updated version. **(See Content Template examples on the X4L West Midlands Website)** The templates are self-explanatory but there are two that need further explanation. These are the numeric input and the drag and drop templates. Numeric input was chosen over text input due to the fact that numeric input required calculation prior to input, adding additional value to the learning outcomes. It was agreed that textual input (alphanumeric) could be better delivered using other methods like multiple choice or gapped sentence objects.

The drag and drop content template was not used due to the number of variables involved in its construction. Instead, if content authors wanted to use drag and drop they were asked to talk through their ideas with the technical designer to see if they could be realised. So although the drag and drop templates were not used, content writers were made aware that this was an option and was available on request.

Content authors were also made aware that these templates could be manipulated slightly to give further variety in design, for example:

- Multiple Choice – could be used as true or false questions
- Gapped Sentence – did not require sentences as such to produce assessment output.
- Sentence Builder – as mentioned in the 'Evaluation Two' section of this document the sentence builder object was evolved by the EFL team into a text sequence event builder.
- Drag and Drop – could be used to tag diagrams, produce object pairs, on to many object correlation and even puzzle / sequence like objects.

So from the initial six templates a whole range of objects could be produced or even a mixture of the above principles could be applied to an object. For example a multiple choice object could contain multiple choice and true or false questions.

Evaluation

2.1 Evaluation One (Main Issues)

As can be seen from the first draft design of the learning object viewer, the initial concept behind the design was the collation of separate learning objects to form a sequential learning package.

The first draft of the object viewer was shown to a number of students, as we wanted feedback on the layout, design and colour schemes used. We wanted suggestions from the student body as to the direction it should take. They were keen to see if their views were reflected in subsequent design changes. This helped motivate the students as they became more enthusiastic about the project, as they saw the changes incorporated in the second phase.

The second draft of the object viewer looked more visually appealing, and much of this design was used in the final objects. The object viewer at this stage was heavily influenced by the NLN learning objects in as much as they would be set at a standard dimension and would incorporate paging rather than a scrolling method of navigation.

It was at this stage the EFL team suggested the use of a number of audio resources, as some of the principles that they wanted to get across could not be solely text based. As these resources were very specialised, the project had to accommodate some additional sound recording.

(See first and second draft of the object viewer on the X4L West Midlands Website)

2.2 Evaluation Two (Main Issues)

As mentioned in preceding section, the students involved in the evaluation were agreeable with the design changes that had been made and now had the opportunity to try out a sample multiple choice assessment. They liked the idea that they could do the assessment a number of times and that the visual feedback provided substantive evidence that learning had taken place.

The project was then taken to the first regional cluster group meeting for X4L, where it was critically analysed by a number of fellow peers. What came out of those discussions was that the links between learning episodes in the object viewer were too embedded and sections could not be easily broken down back into their object components.

It was argued that in FE institutions, lecturers preferred ready made packages of learning, such as the NLN learning objects, however lecturers in the HE sector preferred to have the objects segmented so that they could be more easily tailored to their own teaching requirements.

The links that were in the object viewer were thought to be restrictive in that each package had to have an introduction, content area, assessment and further information section. This allowed for little change.

Armed with these findings, a final design (draft one) was produced. The objects were now separated and completely independent of each other. Original content templates were then modified and existing content information moved across. The new objects, when deconstructed, contained stand-alone content and assessment features.

The paging system was also dropped for a scrolling system, this was mainly a technical issue as it allowed more user control and would be easier for a third party to repackage. For example, they could be printed and there would be no page linking considerations to take into account.

2.3 Finalised Design Evaluation (Technical / User)

The final design, with a range of differing assessments, were tested with end users consisting of students that were involved in the original two evaluations and new students introduced to the project for the first time. The selection of students was chosen for two reasons, firstly because a number of the original evaluation cohort was needed to agree the initial changes and secondly we wanted to see the impact of such changes on fresh students. The reception was good and no alterations were made other than a few textual mistakes.

As mentioned briefly in the 'Content Templates / Information Design' section of this document, the EFL team also suggested the manipulation of the sentence builder into a textual sequence event builder which was added to the design.

It was decided at this stage that all objects would be validated through W3 XHTML strict compliance standards via <http://validator.w3.org>. The CSS style sheets also had to be validated and there were a number of steps taken to conform to the WAI-A accessibility guidelines such as removing all tabular formats and replacing it with CSS controlled layout.

(For more detailed specifications and also for support of these evaluations see the Technical Concepts section)

Content Author Usage

As a final point, it is worth mentioning that the choice of learning object templates selected by the content authors leaned heavily toward the multiple choice and gapped sentence type. This applied equally to both engineering and EFL authors.

Only the engineering authors used the numeric input, although surprisingly enough, both authoring teams used the sentence builder.

The 'drag and drop' and also the image sequence were not used at all, although as mentioned previously, a text sequence was used a number of times by both groups of content writers. **(See 'How To Guides' featured on the X4L West Midlands website. Each guide contains a table listing all objects and their associated assessment types)**

Technical Concepts

3.1 Code design

As mentioned in the 'Design Concepts' section of this document, it was decided that HTML and JavaScript would be used as the code base for the project. This was updated in the later stages of the project from HTML 4 to XHTML 1.0 Strict compliance.

The learning objects were written from a code perspective rather than using a GUI (graphical user interface). The GUI was introduced after the initial design was created for ease of use whilst manipulating templates. The reason behind this was that although many web design applications are generally quite good, they can still slip up by writing clumsy or non-conformant code that may cause some unexpected results.

All XHTML code was written and checked by hand and then validated against the W3 website.

As with all the code throughout the project, the JavaScript assessments were originally authored for the project. It was decided that it was worth the investment in time to generate such code for a number of reasons:

- **Code Manipulation** – Third party applications such as 'Macromedia Course Builder' and 'Hot Potatoes' were restrictive in allowing for the manipulation of the assessment code.
- **File Size** – Many of the third party assessment builder applications included files and information / code by default, that were not relevant to the object itself. This resulted in exploded files size and objects containing redundant files.
- **Cross Browser Support** – The third party assessment builder applications didn't offer the cross browser support the project required. For example, some wrote code only compatible with the Microsoft range of browsers and others wrote that required the most up-to-date browsers to run.
- **Additional Files** – We wanted to write the most self-contained objects as possible with only audio and visual files being externally linked. Third party assessment builders used a variety of methods of web-based functionality, but all seemed to require external link files to run.

CSS layouts were used rather than tabular layouts for visual placement of page elements, to conform to interoperability standards and requests made by disability organisations to give greater application support ranging from web browsers to speech engines

All tabular layouts used throughout the project were used solely for data interpretation. These also included additional tabular information to aid the interpretation of the information by viewers other than web browsers. This included the use of the 'summary' attribute to explain the use of the table and describe briefly the content. The use of 'caption' and table header (th) tags for titling purposes and also the use of the 'scope' attribute to group relational columns and rows. In some cases 'thead, tbody and tfoot' was used to segment the information to be more easily digestible by the viewer / reader.

3.2 Browser Compatibility

The objects are designed to work on version 4+ browsers (Netscape and Explorer). Extensive tests were run to ensure that the pages viewed on such browsers and also the assessment functionality was not impaired by browser choice. Where visual appearance could not be maintained due to lower browser versions, the learning objects degrade well and are still fully functional. The objects have been tested successfully in the following browsers, VLE's and content management systems:

- Microsoft Internet Explorer 4+
- Netscape Navigator 4+
- Opera 7+
- WebCT 3+
- Fronter
- InterLibrary

3.3 Known Browser Bugs and Compatibility Issues

There are a few bugs and browser problems that could not be worked around due to the technology used. These are vendor issues and work arounds could not be developed at a technical design level.

- Netscape 6+ has a print bug that prints blank pages if a fieldset expands over more than one page. **This is documented browser issue and reference to this can be found in appendix i. No solution to this problem was found at the time this document was written (18/08/03).**
- The CSS print functionality will not work in Netscape 4 as using separate CSS media types is not supported. **Solution, upgrade browser.**
- Greek character entities used in some of the engineering will not view in Netscape 4, these entities are not supported by Netscape 4. **Solution, upgrade browser.**

3.4 Platform

As with all web-based technology the main power of its delivery is that it is cross platform compatible, or as close as possible. Using HTML based technologies our project can be delivered to the widest audience possible. Due to the project timescale only the cross browser testing could be achieved based on the Windows OS technology. Objects have not been tested on Mac and Linux systems although great care has been taken to ensure these systems have been accounted for, including working to strict W3 validation standards and specifications.

3.5 Specifications

In addition to working to the JISC project specifications we also set ourselves the target, which we achieved, of working to a number of world web standards. We believed the project would benefit from adhering to these standards, giving it a solid technical and interoperable foundation for the content to rest. Some of standards that the projects worked towards are as follows:

- **XHTML 1.0 Strict Compliance** – All 120 learning object validate via the W3 validation service stating that the object can carry the XHTML compliant logo.
- **CSS Level 2 Compliance** – All 120 learning object validate via the W3 validation service stating that the object can carry the CSS compliant logo.
- **JavaScript 1.1 / 1.2** – JavaScript code has been written to 1.1 standards except in instances such as the drag and drop procedures where JavaScript 1.2 was written due to functionality required. This was done so backward compatibility issues were addressed.
- **WAI Single A Compliance** – All 120 learning objects have been checked against the W3 Web Accessibility Consortium single A compliance checklist for compatibility and bare the WAI-A logo.

3.6 Accessibility and Technical Issues

As already mentioned in the 'Design Concepts' section, a great deal of thought went into the visual and navigational design of the learning objects. This attention to detail can also be seen in the technical design of the project. Some key technical aspects have already been discussed during in previous sections of this documentation. Here are the main technical features that have been implemented in response to various documents on disability such as the W3 WAI and TechDis on-line documentation.

- **Visual Layout** – Cascading Style Sheet layouts were used for all visual positioning other than tabular data information.
- **Tabular Layout** – Tabular layout was confined to the display of information only, implementing additional informational code syntax such as summaries, captions, scopes and table headers. Also head, tbody, and tfoot tags were used in some instances. The inclusion of these elements aid the flow and add relation to information contained within the table assisting non-browser based viewers and readers.
- **Access Keys** – Access keys were added to notable points in the learning objects that users may wish to navigate to. This was mainly used for jumping between questions in the assessments where the user may require the use of the keyboard over the mouse. Obviously this is based on browser support.
- **Tab Order** – The tab index was also set on assessment questions so the user could, after completing a question, tab directly to the next. This too is based on browser support.
- **Large Clickable Areas** – Although not mentioned in the 'Design Concepts' the areas that can be clicked on, have been made as large as possible for those with limited mouse control such as those with motor neural disabilities.
- **Fieldsets** – Fieldsets were used to section form areas together within the assessments. For example, a question may contain a legend, question paragraph and three multiple-choice questions all wrapped within a fieldset. This not only notifies the user that the elements belong to a single question by visually drawing a box around them, but also the software rendering the code such as a browser.
- **Labels** – Labels were added to elements such as radio button to add extra information about the button and also extend the clickable area to the text, allowing the corresponding text to be clicked on to activate the radio button selection. This also increases the clickable area of the form element.
- **Legends** – Legends have been used to add distinct titles to fieldsets.
- **Alt Tags** – All images contain alt tag descriptors of image information. This is part of the validation checks that W3 run via their on-line validator.
- **CSS** – In accordance to disability regulations all style sheets can be removed without notably affecting the usability / clarity of the learning objects. These can also be replaced with user defined style sheets, if they so wish, to change the visual appearance of the objects.
- **Relative Measurements** – Where possible, measurements have been made relative. This is made apparent in the context of font sizes, which allows the user to change the font size via the browser whilst still keeping the text proportional to its surroundings.

- **Pint Friendly** – Different CSS styles were set up for both screen and print. This allows for the print version to be printed in monochrome (excluding non-content images) and produced in a more readable handout format.
- **Consistent Design** – The design and positioning of elements are consistent throughout the 120 learning objects. This aids the user in navigating around the objects as certain things can be expected in certain places. For example, all assessment results are displayed at the end of the learning object.

3.7 Download time and Audio Media

Objects have been designed to be as small as possible. All images have been compressed to an appropriate size and format (jpg or gif). Objects have been designed to be no more than 60kb in size before metadata wrapping and upload, this is excluding those objects using audio files or multiple image sets.

Audio files are saved in MP3 format as this is designed for work in a vast number of players both computer and external based. No specific plug-ins were selected for playback so to allow the user use of their own default MP3 player, minimising plug-in downloads.

3.8 Personalisation

As the objects content is separate from the display information, there is potential for a user to alter the design to fit their own user or corporate identity. They can do this by altering the inline stylesheet or images, which are accessible via most good GUI HTML authoring packages.

Conclusion

Through the design and technical issues discussed within this document, in addition to the pedagogical project foundation, the overall outcomes have been pleasing. The project has struck a good balance between informational learning design and technical delivery.

Supporting evidence to this documentation can be found on the X4L West Midlands website at:
<http://www.solihull.ac.uk/x4l>

Appendices:

Appendix i – Netscape 6+ print bug screen information and URL Reference

User-Agent: Mozilla/5.0 (X11; U; Linux i686; en-US; rv:1.2.1) Gecko/20021210 Debian/1.2.1-3
Build Identifier: Mozilla/5.0 (X11; U; Linux i686; en-US; rv:1.2.1) Gecko/20021210 Debian/1.2.1-3

If a page includes a box (fieldset) that goes across the end of page in the Print formatting (either Print or Print Preview), then the result of the rendering is a blank page

The page looks fine on the screen in the navigator Window but as soon as the printing renders it, then the page comes all white (ie. only the header / title without anything else -> blank)

it's probably the surrounding box (fieldset) that cannot go across page boundaries

Reproducible: Always

Steps to Reproduce:

1. create a simple html page
2. define a fieldset (box) inside a form
3. put some lines with text inside that box in order to have more than a page to be rendered on the printer (or the print preview)
4. File / Print Preview -> see how the page looks different to what you have in the screen

another example can be seen here : http://adren.mine.nu/~cyril/bad_print.html

Actual Results:

nothing but the title is shown (blank page)

Expected Results:

the page should look like what is on the screen (several pages with the text inside the box)

Reference to bug taken from - http://bugzilla.mozilla.org/show_bug.cgi?id=191308

Appendix ii – Table of Image Resources

(Updates made 03/2005 to comply with new SCRAN licence restrictions)

Image File Name:	Object:	Source:
background.gif	All	Designed for project
submit.gif	All	Designed for project
top_bg.gif	All	Designed for project
top_image.gif	All	Designed for project
valid-xhtml10.gif	All	http://www.w3.org
vcss.gif	All	http://www.w3.org
wcag1a.gif	All	http://www.w3.org
reset.gif	All sentence builder objects	Designed for project
Audio.gif	All object containing audio	Designed for project
img_skydivers.jpg	risk_vocab_dev.html	SCRAN: ID 000-000-630-630-R Designed for project
img_gaspropulsion.jpg	intro_gas_prop.html	SCRAN: ID 000-190-004-360-R Designed for project
img_gyroscope.jpg	intro_gyro_instruments.html	SCRAN: ID 000-180-001-010-R Designed for project
img_instrumentpan.jpg	intro_gyro_instruments.html	Photographed for project
img_tailrotor.jpg	intro_heli_tail_rotors.html	SCRAN: ID 000-000-428-433-R Designed for project
img_mahrotor.jpg	intro_heli_main_rotors.html	SCRAN: ID 000-000-433-754-R Designed for project
img_earlyaircraft.jpg	early_aircraft.html	SCRAN: ID 000-000-463-463-R Designed for project
img_livingroom.gif	prepositions.html	Designed for project
img_hookes_graph.gif	hookes_law.html	Designed for project
img_rudder1.gif	intro_flight_control.html	http://olgol.com
img_rudder2.gif	intro_flight_control.html	http://whyfiles.org
img_servos.jpg	intro_servo_mech.html	http://www.gefanuc-europe.com
img_enginecontrol.gif	intro_engine_control.html	Designed for project
img_detachedhouse.jpg	adjective_order.html	SCRAN: ID 000-000-450-040-R Designed for project
img_izod.jpg	impact_testing.html	Photographed for project
img_hardness1.jpg	hard_testing.html	Photographed for project
img_hardness2.jpg	hard_testing.html	Photographed for project
img_rust.jpg	corrosion.html	Photographed for project
img_galv.jpg	cor_inhibitors.html	Photographed for project
img_plasticcoat.jpg	cor_inhibitors.html	SCRAN: ID 000-000-460-716-R Designed for project
img_radiorec.gif	radio_rec.html	Designed for project
img_rrengine.jpg	intro_eng_combustion.html	Photographed for project

img_compressors.jpg	intro_compressors	SCRAN: ID 000-000-429-373-R Designed for project
img_gasenginecross.gif	intro_exhausts.html	http://whyfiles.larc.nasa.gov
img_charlieuh1c.jpg	intro_heli_components.html	http://www.pilotfriend.com
img_tensile1.gif	tensile_testing.html	Photographed for project
img_tensile2.gif	tensile_testing.html	Photographed for project
img_closedloop.gif	closed_loop.html	Designed for project
img_interatomicds.gif	grain_structure_pt2.html	Designed for project
img_crystalstruct.gif	crystal_struct_st1.html	Designed for project
img_periodictable.gif	chem_bond_period_pt1.html	Designed for project
img_periodictable.gif	chem_bond_period_pt2.html	Designed for project
img_manufmaterials.gif	manufac_materials.html	Designed for project
img_vickershard.gif	assess_hardness.html	Designed for project
img_deflectioneq.gif	supporting_load_pt1.html	Designed for project
img_deflectioneq.gif	supporting_load_pt2.html	Designed for project
img_deflectioneq.gif	supporting_load_pt3.html	Designed for project
img_breakingloadeq.gif	mech_testing_pt2.html	Designed for project
img_eridsen.gif	mech_testing_pt2.html	Designed for project
img_supportload.gif	extloads_intforces.html	Designed for project
img_supportload.gif	stress_tensile.html	Designed for project
img_stresseq.gif	stress_tensile.html	Designed for project
img_compmoulding.gif	comp_moulding.html	Designed for project
img_facecentcubic.gif	crystal_struct_st3.html	Designed for project
img_hexdosepacked.gif	crystal_struct_st3.html	Designed for project
img_crystrucptmetalsass.gif	crystal_struct_st3.html	Designed for project
img_bodycentcubic.gif	crystal_struct_st2.html	Designed for project
img_metalgrain.gif	solid_grain_struct_metals_pt1.html	http://quest.arc.nasa.gov
img_staineq.gif	stress_stiffness.html	Designed for project
img_youngsmodeq.gif	stress_strain_behaviour_pt2.html	Designed for project
img_youngsmodeq.gif	stress_strain_behaviour_pt1.html	Designed for project
img_tensile1.gif	stress_strain_behaviour_pt1.html	Designed for project
img_stress4to7.gif	stress_strain_behaviour_pt1.html	Designed for project
img_stress8to10.gif	stress_strain_behaviour_pt1.html	Designed for project
img_greekexample1.gif	radiography.html	Designed for project
img_elasticityeq.gif	mech_testin_pt1.html	Designed for project
img_postcard.gif	present_continuous_ps.html	SCRAN ID 000-000-466-071-R Designed for project
img_dendrite.jpg	solid_grain_struct_metals_pt2.html	http://quest.arc.nasa.gov
img_greekexample2.gif	crystal_struct_st4.html	Designed for project
img_plastics.jpg	plastics_in_action.html	SCRAN ID 000-000-470-859-R Designed for project