More Patterns for Tailoring E-Learning Materials to Make them Suited for Changed Requirements

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Abstract: Creating appropriate E-Learning material is difficult and expensive. Therefore, a re-use of existing material would be desirable. But this often fails as the material is usually context specific. When it is re-used in a new context, it often does not fit the needs of the new usage scenario. Hence, an adaptation to the new scenario of usage is needed.
In this paper we present a new fragment of our pattern language for E-Learning material adaptation, which we presented first on VikingPLoP 2006. The patterns focus on how the adaptation process to E-Learning material can be executed. We first give a general introduction on the adaptation of E-Learning material. Then we introduce our patterns.

0 Introduction

Creating high-quality E-Learning material is a time and cost consuming task. Re-using existing E-Learning material could lower these costs. But often a one-to-one re-use of the existing material is not possible, as the new scenario of usage differs to a certain degree from the original usage scenario. If the difference is not too wide, it is still cheaper to change and then re-use the existing material, than to create new material. But to achieve a high quality it is necessary to adapt the existing material to the new usage scenario.

In many cases it is necessary to perform several adaptations in order to achieve a good result. Often the persons who have to perform the adaptations are not experts in performing all needed adaptations. But normally they have a certain basic knowledge on how to proceed. For example they may know how to change the size of an image. But they may not be experts in changing the design of the material. Therefore it is useful to provide the knowledge of experts on adaptations

to persons who have to perform the processes. This is the aim of our adaptation patterns. They are part of a pattern language describing how to perform the processes needed for tailoring E-Learning material to make it suited for changed requirements. In our paper at VikingPLoP 2006 [7] we presented several patterns that are part of this pattern language. In this paper we will present three new patterns as an extension to the introduced pattern language.

As described in our previous paper, there are two kinds of patterns relevant for a successful adaptation of E-Learning material:

1. *Adaptation patterns* describe how to perform an adaptation. Whenever someone wants to adapt E-Learning material to make it suited for changed requirements he / she finds the description what to do in those patterns.

2. *Supporting patterns* describe how to solve typical problems you might run into during the execution of an adaptation process.

In our previous paper we presented the following three adaptation patterns:

- *Design adaptation*: This adaptation occurs for example if material created for one company is re-used in another company. Then often the layout of the material has to be changed in order to fit to the corporate design of the new company. The pattern describes the steps needed to adapt the design.

- *Printability*: Mostly E-Learning material is optimized for working with it on a computer screen. But often learners want to print out at least parts of the material. Then a print optimized version has to be created. The solution of the pattern describes how a separated print version can be created.

- *Translation*: If the learners do not understand the language in which the material is provided, the material has to be translated to a language that the learners are able to understand. This pattern describes how to perform a translation and what has to be taken into account before, during, and after translating the text.

In addition we presented two supporting patterns:

- *Correct Arrangement of Elements*: There are several adaptations where it is needed to change the arrangement of the elements of your E-Learning material in order to make the arrangement suited for the new requirements. This pattern describes how you can re-arrange the elements in a way that they comply with the requirements.

- *Correct Length of Text Blocks*: If you have to exchange text parts with other text parts it often occurs that the length of the new part is different than the one of the original text part. Then you have to change the size in a way that it fits to the requirements. This pattern presents two possibilities how you can correct the length of a text block: You can shorten or lengthen its content.

All adaptations described in the adaptation patterns of our pattern language are connected to other adaptations. This means that if you perform one adaptation this might lead to a need for another adaptation. This is expressed in Fig. 1. (If the execution of one adaptation leads to a need for a second adaptation, an arrow points from the first to the second adaptation.) In the patterns this is described in the section "Connected patterns".

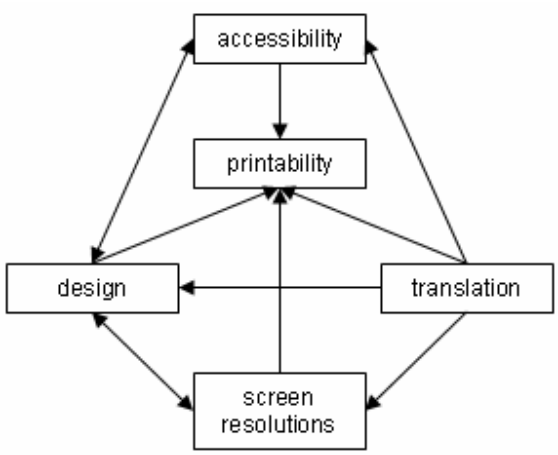

Figure 1: Connections between Adaptation Patterns.

In this paper we present two new adaptation patterns: "Accessible E-Learning Material" and "Screen Resolution" and one new supporting pattern "Deal with Frames".

As we explained in our VikingPLoP paper, adaptation patterns can be classified by three groups: Changes to the content, changes to the layout and changes with a technical background. This has also been discussed in detail in our previous paper. The adaptation patterns presented in this paper belong to the following groups:

Accessible E-Learning Material mainly belongs to the adaptations changing the layout of existing material, e.g. by using special color schemes or larger fonts. But it also changes the content, e.g. if you change the material in a way that it provides additional written information for persons that cannot hear or if you provide descriptions for images etc.

Screen resolution also mainly changes the layout, as the layout has to be suited for several resolutions. But it is also an adaptation with a technical background.

1 Accessible E-Learning Material

Intent: Adapt existing E-Learning material in order to make it usable for persons with disabilities.

Context: E-Learning is a chance for many disabled persons to get access to continuing education. But often authors do not have disabled persons in mind when creating E-Learning material. Due to this persons affected by certain disabilities or impairments have to face limitations if they want to access E-Learning material. Therefore it might be necessary to change existing material if it should be suitable for persons with disabilities.

Problem: You want to change existing E-Learning material in a way that it is accessible for persons with one or several kinds of disabilities and impairments. There exist different kinds of disabilities and impairments. Therefore you have to take care of the specific limitations that are caused by special disabilities or impairments. What do you have to keep in mind if you want to make your material accessible?

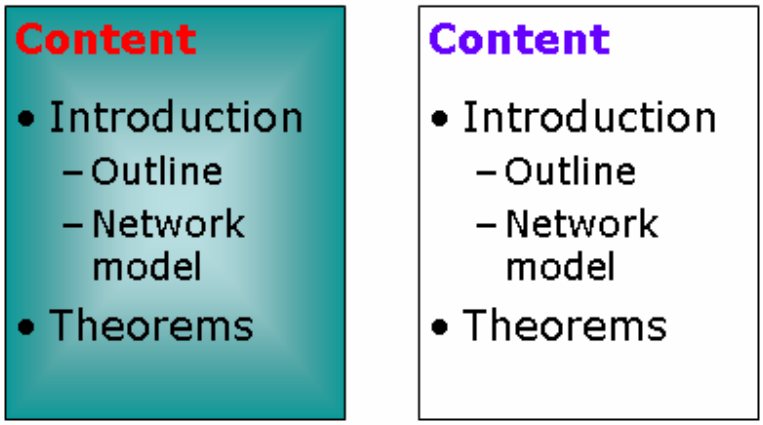

Figure 2: Example of a navigation, not suited (left) and suited (right) for color blinds.

Fig. 2 shows two versions of a part of a navigation of an E-Learning course. The first part is not suited for persons that are red-green color blind, as they cannot read the red header in front of the green background. In addition the irritating background might cause problems to persons with visual impairments. By contrast the navigation on the right is better suited for persons with visual impairments.

Forces:

- Often accessibility is not taken into account during the design of a new E-Learning course. The material you want to re-use is not suited for one or several kinds of disabilities and / or impairments.
- You want to make the material available to users with one or several kinds of disabilities and / or impairments.
- You have to adapt the material if the following impairments or disabilities occur in your

target group: visual impairments, hearing impairments, disabilities regarding the body, and mental impairments are relevant.
- You have to adapt the existing material in a way that those of your target users who have certain disabilities or impairments can access the material.
- If someone is not or only limited able to speak this has no relevance on his / her ability to access E-Learning material.
- You have to keep the maintenance effort at a reasonable level.

Solution: When you start adapting your material you have to find out which disabilities and impairments occur in your user group. Then you have to find out which limitations exist for each relevant disability or impairment. If the material is not suited for persons with special impairments and disabilities you have to eliminate the factors that might lead to problems.

The following groups of disabilities and impairments have to be regarded when trying to make E-Learning material accessible:
- Hearing disabilities (hardness of hearing and deafness)
- Visual disabilities (limited powers of vision, blindness or color blindness)
- Motor disabilities (reduced or missing ability to move certain limbs or the whole body)
- Language disability (reduced or missing ability for a correct use of speech)
- Disabilities with an effect on the ability to learn (problems in learning writing, calculating, etc. as well as problems with learning in general)

Often it would be necessary to provide one version for each kind of disability. But this would increase the maintenance effort dramatically in order to achieve perfect accessibility for all kinds of disabilities. Therefore you have to find the balance between a perfect accessibility and a bearable maintenance effort: Try to change the original version in a way that it is suited for most disabilities. Regarding the groups of disabilities mentioned above this means:

Hearing disabilities:
These persons are not or only limited able to access audible information. You have to provide an alternative access. Therefore it is not necessary to create a new version of content. You can add a transcription for audio information and a video with a sign language interpreter. You should allow users to select if they are able to hear the information or if they need the transcript or interpreted version of the information.

Visual disabilities:
Persons affected by these disabilities have problems with visual information. There are different kinds of visual disabilities. Some persons have a restricted or no ability to see. Others have problems in seeing certain colors. The first group of persons has to use assistive technologies to access the material. The second group can access visual information in general. But they cannot differentiate certain or all colors.
For the first group it is often not necessary to provide a complete new version. To make the material accessible for this group it has to be optimized for the technologies they use to access the material. In addition you have to think of providing an alternative version for all visual information, e.g. a text describing the content of an image. This is addressed very well in the

principles and guidelines presented in the web content accessibility guideline (WCAG) of the W3C [6]. You also have to think of how the material can be manipulated, e.g. to navigate in the material or to fill out assessments.
If you have to adapt the material for color blind persons you have to think of the following: How is color used in the material? Is it used to transfer meaning? E.g. often red is used to indicate danger or that something is wrong, whereas green is used to indicate that everything is all right. In those cases you should change the colors in a way that they are accessible for color blinds as well. For example in [4] a color pallet is provided that is barrier free for color blinds.

Motor disabilities:
For persons with these disabilities normally you do not have to provide an additional version. But you have to assure that your material is accessible via mouse as well as via keyboard.

Language disabilities and *disabilities reducing the ability to learn*:
For these disabilities mostly it is useful to create a new version of the material, because they have requirements that are rarely compliant with the requirements of other disabilities.

With regards to the limitations of disabled users E-Learning material is quite similar to web pages. There exist quite a lot of guidelines on how to create accessible web pages. E.g. W3C [6] has a very detailed guideline on that topic. You should take this work as a basis for adapting your E-Learning material. In addition you should focus on the features that differentiate your E-Learning material from web pages: E-Learning material aims at teaching the learner. It has a certain order and the elements have a certain purpose. You always have to keep in mind that persons with disabilities do not have access to all elements. Therefore you have to find out how the learning target can be achieved with limited possibilities.

Steps needed to execute the solution:

1. Find out which disabilities and impairments have to be taken into account
2. Find out which limitations exist for the relevant disabilities or impairments
3. Check the material regarding the relevant limitations
4. If limitations exist, change the material in a way that the limitations do not raise problems. Consider that you only provide an additional version if contradicting requirements exist for the different disabilities and impairments.

The order of the steps you have to perform to achieve accessible material is fixed.

Known uses: There exist lots of guidelines in the area of web accessibility on how to create accessible web content. For example W3C has published a guideline [6] that explains in detail based on several criteria how accessible web content can be created. In addition making material accessible for users with disabilities becomes more and more relevant in the area of E-Learning. For example Elaine Pearson and her colleagues work on the creation of re-usable, adaptable and accessible E-Learning material [2].

Consequences:

Positive:

- The material is accessible for users that have the disabilities and / or impairments you have taken into account.

Negative:

- It is quite a high effort to make the material accessible.
- If you have created several versions you have a high maintenance effort.

Related patterns: Not known

Connected Patterns:

- Design (Changing material with regards to accessibility changes the layout of the material. This can get into conflict with design guidelines. Therefore you should check if you need to do a design adaptation after executing the accessibility adaptation.)
- Printability (If you have changed the size or the arrangement of some elements you should check if the print version still fits to the new version of your material and if not you should create a new print version.)

Used Patterns:

- "Deal with Frames" used by "Change the material in a way that the limitations do not raise problems". (If you change the material to make it accessible for blinds you should avoid frames, as they cause problems with screen readers.)
- "Correct Arrangement of Elements" used by "Change the material in a way that the limitations do not raise problems". (Certain accessibilities make it necessary to provide larger images and font sizes. This can change the order of the elements within the material. Then you should check if you still have a correct arrangement of the elements. If not you should change it.)

2 Screen Resolution *

Intent: Adapting material to use it for several screen resolutions.

Context: Users access the material with different screen resolutions. If the material is designed only for one specific resolution users with different resolutions might get undesirable effects when accessing the material, e.g. undesirable scroll bars. Therefore you should adapt the material in a way that it is suited for all screen resolutions your users might use.

Problem: You want to make the material usable on screens with different resolutions. How do you achieve this?

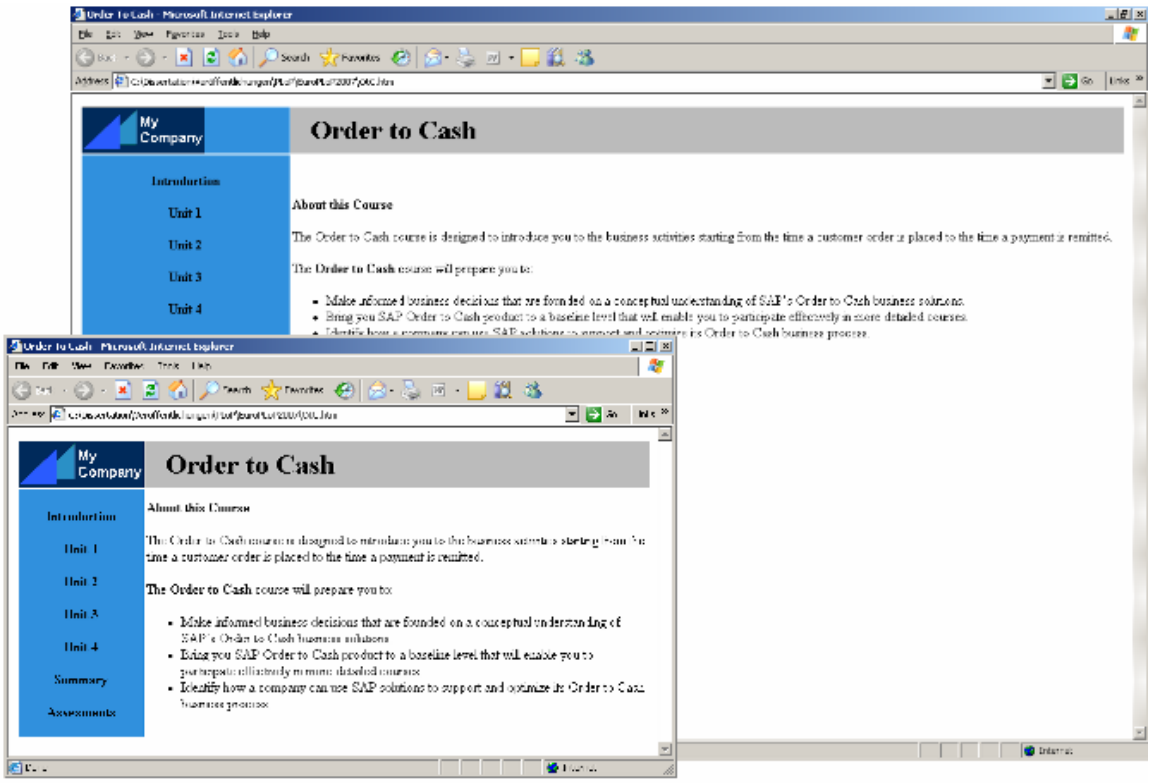

Figure 3: Example of a resizable course.

Fig. 3 shows a screenshot of a course that is resizable even to quite small screen resolutions. Even with a browser that is set to a very small size this course can be comfortably accessed.

Forces:

- The existing material is designed for one specific screen resolution.
- In the group of your target users additional or other screen resolutions are used.
- You have to change the existing material in a way that it can be viewed on several screen resolutions without problems.

Solution: To allow users to access the material with different screen resolutions you should optimize the material for the resolution that is mostly used.
Therefore you have to know the resolutions used by your users. If you do not have this information you should search the web for the resolution that is currently the most popular one. You can find information on this in certain web statistics, e.g. at "http://www.sitetrafficstats.com/screen_resolutions.php?". You then optimize the material for this resolution.
In addition you should apply a so called "liquid" design [5] that adapts to the size of the window in which the material is displayed. If some graphical elements are too big for small resolutions, you should try if you can provide a smaller version of these elements. But you have to make sure, that the elements are still readable. If some graphical elements are not readable after resizing them, you should provide a thumbnail with a link to a larger version of the element.
Make sure that your changes do not have a negative effect on the navigation, e.g. by cutting of parts of the navigation. There are two possibilities how navigation can be realized in E-Learning material: Content and navigation are separated or navigation is part of the content. In the first case the navigation normally is created by the software used to view the material. In this case it is hard or often even impossible to adapt the navigation. In the second case the navigation is provided with the material and therefore can be adapted as part of the material.
To be sure that your material can be accessed via several screen resolutions you should test the material by using the screen resolutions your users have. The order of the steps you have to perform to adapt the material to several screen resolutions is fixed.

Steps needed to execute the solution:

1. Find out which screen resolutions have to be taken into account
2. Optimize the existing material for the resolution mostly used
3. Use a liquid layout
4. If possible provide a small version for graphical elements that are to big for small resolutions
5. Make sure that the navigation stays accessible for all resolutions
6. Test your material with all relevant screen resolutions

Known uses: Many web pages in the internet are created in a way that it is possible to access them with different screen resolutions. Ian Graham gives a very short overview on how to deal with this problem in his pattern "Two-year-old browser". Jakob Nielsen provides very detailed solutions how to solve this problem. For example in 2006 he published an article on his homepage that describes how to optimize web pages for several screen resolutions [3]. But he only takes into account web content.

Consequences:

Positive:

- The material can be accessed via different screen resolutions.
- If you know for which resolutions you have to optimize the material and which resolution is mostly used, the material is adapted in a way that it perfectly fits most of your users' needs.

Negative:

- It is quite a high effort to provide material that is resizable for different resolutions. If you do not know the used resolutions of your target users the effort is even higher.
- If you do not know for which resolutions there might be some users that are not satisfied with the material as they use a resolution that limits their access to the material.

Related patterns: "Two-year-old browser" [1] gives a very rough overview of how to deal with the problem that users might use an older browser version that does not support all features available in new versions. "Liquid layout" [5] focuses on how to achieve a liquid layout which is only part of the solution proposed here.

Connected Patterns:

- Design (By providing a layout suited for another screen resolution it might be that you have to change the layout in way that it is not fitting to the design guidelines anymore. Therefore you should check if you have to perform a design adaptation.)
- Printability (If an additional print version exists and you have changed elements in the original version you should check the print version if it still fits to the original version.)

Used Patterns:

- "Deal with Frames" used by "Use a liquid layout". (When you adapt the material to access it with a smaller screen resolution, frames can cause undesirable scroll bars. Therefore you should avoid frames when adapting material to make it suited for several screen resolutions.)
- "Correct Arrangement of Elements" used by "Use a liquid layout". (Adapting the material to make it accessible with several screen resolutions might mean that you have to change the order of some elements to allow all elements to be visible on the screen. Therefore it might be necessary to correct the arrangement of some elements.)

3 Deal with Frames *

Intent: Create HTML material that avoids frames where possible and reasonable and where this is not possible think of a reasonable use of frames.

Context: There are several adaptations where frames in HTML sides could cause problems, like scroll bars when using different screen resolutions, or problems with screen reader software for persons with visual impairments, or browsers that are not able to display frames etc. If your material uses frames and you have to perform these adaptations you will face the problem that you have to avoid the use of frames.

Problem: You perform an adaptation that causes problems when frames are used: Nasty scrollbars appear, screen readers are not able to read the content in a reasonable order, etc. As your existing material uses frames you have to think of how you can eliminate the problems that occur when using frames. How can you deal with frames to avoid the problems?

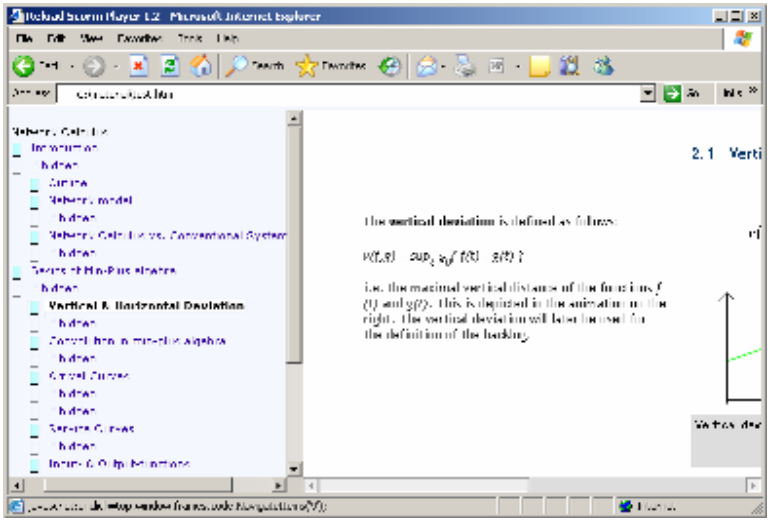

Figure 4: Frames on a smaller screen resolution.

Fig. 4 shows, that if you view frames with a small screen resolution, this can cause many unsightly scroll bars.

Forces:

- Your material uses frames.
- You have to perform an adaptation where the use of frames could lead to problems.
- You want to avoid these problems.
- You have to adapt HTML material that contains frames.

Solution: You have two possibilities how you can deal with frames:

a) You can avoid the use of frames. This means that you have to eliminate the frames and structure the content in a different way, e.g. by using layers and tables.

b) You can keep the frames (if this is reasonable), but you should think of the limitations and side effects that can occur. E.g. if persons with disabilities want to access the content the frames should be titled meaningful and the relationship between the single frames should be clear. In addition you should provide a “noframes”-section that allows access to the content if the tool with which the user accesses the material is not able to handle frames.

Known uses: This pattern is based on the experiences of several persons working in the area of web design, e.g. the W3C web content accessibility guidelines provide suggestions how to deal with frames [6]. In addition there are other patterns considering this problem, like “No frames on public sites” from Ian Graham [1].

Consequences:

Positive:

- The content will be more usable.

Negative:

- Depending on the solution you chose, the effort might be very high.

Related patterns: “No frames on public sites” [1]

Used Patterns: None

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