

## Crossing the Ts and Closing the Tags: Improving Web-Standards Compliance in Open Source E-Learning Platforms

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**Abstract:** In this paper we argue that Web-standards compliance of open source e-learning platforms is an important issue which has to be thoroughly addressed. The draft evaluation of randomly selected open source e-learning platforms, against usability and accessibility standards, resulted in an unexpectedly high failure rate for the validators employed and eventually set the basis for the examination of learning management systems with respect to Web-standards. In an effort to improve the level of Web-standards compliance, we attempt to identify the type of the usual mistakes, along with their origin, and suggest appropriate solutions. More specifically, we attempt to classify the errors according to the alleged origin source by testing demonstrative installations of e-learning products as provided by their developers.

In the first part we discuss in theoretical level the way in which contemporary content management systems affect the web publishing process, as opposed to the static hypertext authoring of the past. In addition, we argue in favour of Web-standards compliance especially in the case of e-learning platforms. In the second part, which is oriented to practical solutions, we examine, in a per e-learning platform basis, characteristic examples of code fragments which fail to comply with Web-standards and we demonstrate the appropriate solutions. An important part of this section is the distinction between the errors found in the original source code, which should be attributed to the developers and the errors found in the markup code of the content, which should be attributed to the user who provided the content.

The contribution of this work is bi-fold:

- At the theoretical level it examines the importance of Web-standards with respect to open source e-learning tools and argues in favour of compliance with the established standards in order to enhance usability and accessibility for the benefit of end-users.
- At the practical level it provides examples of solutions to the most common errors observed in the evaluated platforms and proposes the implementation of techniques that improve Web-standards compliance.

The main conclusion, reflected in the title of the paper, is that most Web-standard compliance failures can be easily avoided by the use of well-known techniques and practices already established. In the modern hypertextual environment, “closing the tags” and following the Web-standards seems to be, more or less, the equivalent of our childhood’s “crossing the Ts and dotting the Is”!

**Keywords:** Web-standards, LMS platforms, usability, validators, markup and stylesheets

### 1. Introduction

“Crossing the Ts and dotting the Is” is a well known expression which refers to paying attention to all the details, which will make one’s work complete, accurate and well-formed. In a direct analogy we argue that Web applications and in particular e-learning platforms, should be thoroughly examined in every aspect against standard Web technologies. Compliance to standards is the fundamental step towards building accessible e-learning applications and reusable content. These two factors are more important in distant learning, where users access the same content through various devices and user interfaces and where the educational content is composed by reusable learning modules, which should be pluggable to different learning platforms.

Keeping a website standard compliant, though it requires meticulous work, is relatively easy, since the grammars to be followed are clear enough and not complicated; it requires adhering to a limited set of rules, such as closing the markup tags and quoting the values of the attributes, which may be accomplished by hypertext authors as easily as any literate student should accomplish crossing the

t's. Yet, the net profit for the whole community of Web users far exceeds the invested by the developers effort and makes web content more accessible, navigable and findable (Zeldman, 2006), all of which contribute to our common informational wealth.

The line of argumentation is reflected in the structural organization of this paper and in brief consists of three main parts: a) advocacy in favor of Web-standards compliance especially in the case of e-learning platforms, b) categorization by terms of origin of common failures in validity checks for open source tools and c) demonstration of paradigmatic solutions for each case. Finally we conclude that the goal of Web-standards compliance can be reached with reasonable and cost effective effort in the case of web based e-learning systems and that this goal is a worth targeting one.

## **2. From trained developers to content management systems**

Several years ago, web site development was performed mainly by trained developers, who employed the limited set of HTML tags to structure and format their content. A few years ago, the advent of new web technologies, like CSS and JavaScript, new browsers (e.g. for mobile phones) and the increase of the number of Web pages created the need for standards in web site development (W3C Quality, 2006). The adoption of standards by commercial web site development tools has leveraged the burden of compliance for web site developers. The emergence of Web 2.0 applications resulted in a new kind of web content. The social media web content is written by users, who are usually unaware of Web-standards. Content is edited and formatted using text editors, which are embedded in the web pages and is deployed to the same web pages in a dynamic manner.

In the same concept, web based e-learning platforms allowed educators to create, format and deploy content online, with respect to the limitations of the web based editor and the platform's administrative tools. In contrast to the traditional web site editing, where each page was created from scratch, the creation of web content in an e-learning platform takes place in a more controlled environment. The result is a blend of user provided text, which is formatted in an embedded WYSIWYG editor, and formatting instructions, which are added by the creators of the e-learning platform.

All research works that evaluate e-learning platforms focus on their usability (Paulsen, 2002), their ability to support learning activities and adapt to students' needs (Graf & List, 2005). The evaluation is based both on objective criteria and on the subjective opinion of students and educators. Recent research works that link usability with the aesthetic perception of e-learning platforms' design (Stenalt & Godsk, 2006; Mbipom, 2009) combine results from extensive human surveys and from the processing of eye-tracking information in order to find pages which are visually pleasing to sighted users.

Undeniably, the first step in developing accessible, usable and aesthetically correct web sites is to guarantee compliance with web standards (Bevan, 2005). A web document that adheres to web standards, consists of valid source code and is properly structured and semantically marked-up is less prone to broken links and content misplacements, is more likely to work in mobile browsers and can be easily adapted to the special needs of users with disabilities.

E-learning platforms have a lot to gain from compliance with web-standards. First, the development and future maintenance of the content is easier and quicker. Second, there is increased compatibility and adaptability of content to different browsers and printing formats. Third, it is easier for screen readers and browsing devices to access content. Finally, when content is separated from semantics and presentation, the aesthetic improvement of the web site becomes easier, since it is clearly restricted into the presentation part, without affecting content and semantics.

When evaluating a web site for compliance with standards, we can employ any of the existing validators, -e.g. W3C's CSS Validator (2009), W3C's Markup Validator (2009), among others-, which parse the code of the page and provide extensive reports on the errors of each web page (Johansson, 2008). In the case of e-learning software, accessibility and compliance to standards is a small, though fundamental, part of the evaluation process (Catalyst, 2004). The deployment of an online course comprises the positioning of activities, educational material and supporting applications in the main page of the course, which is usually based on a predefined template, the editing of user provided content, such as course announcements, questions and answers to the forum etc. Consequently, the validator should verify, among others, the well-formedness of static content, the correctness of page structure and the appropriateness of user generated content.

As far as user generated errors are concerned, few things can be done to guarantee compliance to standards. On the other hand, software errors that lead to non-compliant content can be located and fixed, as shown below in the examples section.

### **3. Advocating Web-standards for e-learning platforms**

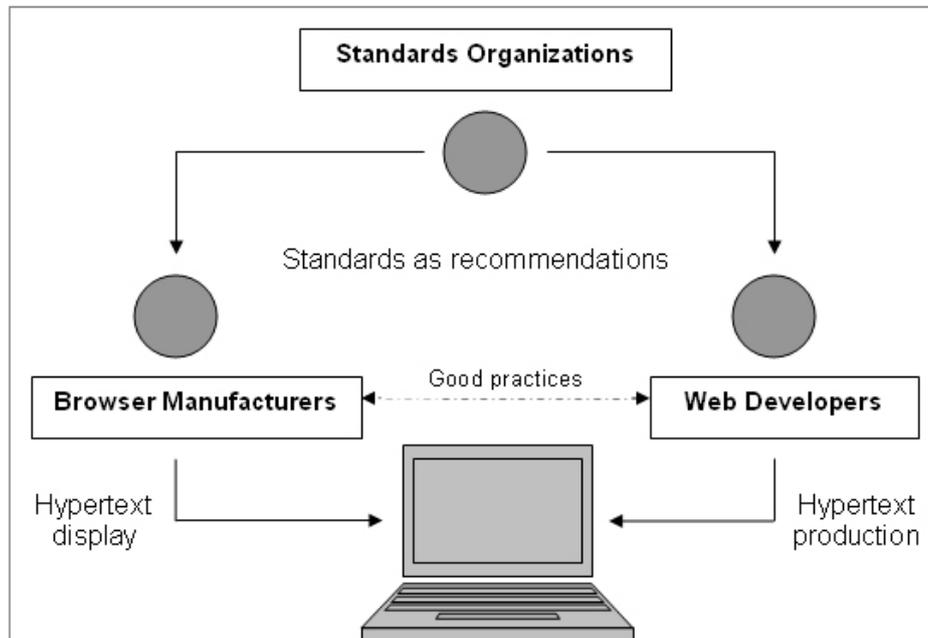
The term “browser wars” was coined in order to describe the extreme antagonism between the two major browsers of the nineties: Internet Explorer and Netscape. It was a time when each browser employed non-standard features in order to be more appealing to users and thus increase its market share. In turn, the leading market share would make Web developers code utilizing the non-standard features in their quest for larger audiences. The net result during the first major browser war was a messy situation of sloppy markup code, multiple copies of the same hypertext in order to address the diverse requirements of each browser, a huge waste of man-hours and frustrated end-users encountering “best viewed with browser X” buttons.

As in all cases of contrariness a strong grassroots-driven request for consensus and regulating bodies emerged. In the case of the Web the request was formatted as an online movement in favor of what later became known as Web-standards (The Web Standards Project, 2002). Though not clearly defined during the first period, Web-standards eventually turned out to mean formal grammars for Web technologies published as recommendations by highly acclaimed organizations. In particular, nowadays, the limited set of Web-standards referenced in relevant literature and discussions includes the grammars of the markup languages and cascading stylesheets, along with JavaScript, the most widely used client-side scripting language, formally known as ECMAScript (ECMA International, 2008). The recommendations for the markup languages and the CSS are issued by the World Wide Web Consortium and for JavaScript by ECMA International. Accordingly automated tools for validation against the standards which parse the source code and check for inconsistencies or syntax errors were developed, the most well-known and intensively used being the W3C’s markup and stylesheet validating services; in fact in layman’s terms a valid website is one that successfully passes the tests of these two validators.

The notion of Web-standards became quickly highly popular and the common denominator to all Web related discussions due to the fact that the standard compliant employment of the particular technologies is considered the cornerstone of all usability and accessibility issues as far as Web content is concerned. Indeed, the comprehensively referenced Web Content Accessibility Guidelines 1.0 recommendation of the W3C, suggests the use of standard technologies according to specification in order to increase content accessibility (Guenaga et al, 2004). Since usability and accessibility constitute the primary field of the ongoing discussion about Web interfaces (Nielsen & Loranger, 2006), the role of Web-standards remains critical and on the top of the agenda.

We have argued before that there are three main poles, as far as the standards issue is concerned, playing distinct roles in the way content is delivered to the end-users via the Web, one of which has significantly more influential power than the others (Giannakoulopoulos, 2007); at least that was the case up to a few years ago, but, as we will argue in the following paragraphs, there are certain signs which reveal that the power distribution is getting more normalized as time goes by.

Consider the diagram in the following Figure 1, which depicts the flow of Web-standards implementation from the initial recommendations up to content delivery to the screens of end-users.



**Figure 1:** Web-standards tri-polar implementation to delivered hypertextual content.

The diagram reads as follows: the standards organizations publish formal grammars of Web technologies; though available in the public domain, those recommendations are particularly addressed to browser (and other displaying software) manufacturers and to Web developers in order to be implemented in hypertext construction (on the side of the developers) and to displaying engines (on the side of the manufacturers). It is worth noting that the major browser manufacturers are members of the W3C, hence they usually participate in the discussion prior to the publications of recommendations. Manufacturers and developers mutually exchange feedback on good practices by means of employment or posts in public discussions, and each pole utilizes the technologies in its own respect.

The pole of the manufacturers was considered the more powerful one due to the internal market structure which accurately reflects what is described in economic theory as an oligopoly. On the other hand the standards organizations lack the regulatory power to enforce the implementation of their recommendations and only partially specific types of standards have found their way into legislation - namely the ones concerning accessibility issues for people with disabilities (Craven & Klaus, 2008). As far as the pole of the developers is concerned, its members were obliged to follow the decision of the browser manufacturers due to the fact that the oligopoly allowed only but very few choices to end-users; developers whose constructions did not display correctly to the major browsers had no luck in the business, no matter how standard or well-designed those constructions were.

Although the situation remains for the most part the same, we tend to believe and argue that we are heading towards a more normalized power distribution with respect to Web-standards. There are various indicators which support our argument, among which the most prominent are the increasing awareness for the role and mission of standards organizations, the success in terms of market-share of the new generation of standards-compliant browsers (e.g. Firefox, Safari, Opera etc), and the growing literature and media coverage for the issue of Web-standards. But there is one factor we consider the most important and relevant which supports our argumentation: the extended use of content management software, under which most if not all e-learning platforms are classified, for the production and delivery of Web content. Though there are no accurate and comparable statistical data on the rate of growth with respect to the functional installation of e-learning platforms, or of content management systems in general, it is common grounds that their use keeps on growing, as evidenced by the number of downloads available in software distribution sites.

Taking for granted that the use of dynamic, database driven, e-learning and CMS platforms keeps growing, we reach the conclusion, in theoretical level, that the Web developers pole in the Web-standards implementation flow has strengthened its position, due to the increased internal density

which results from the use of common software for hypertext delivery. In other words, the community of developers is as not as fragmented as before, but instead unites around common practices such as the ones provided by the platforms. Up to the establishment of those common practices the browser manufacturers had the advantage that the developers, being fragmented and each one trying to employ its own techniques, would be obliged to code in a way that their content would be correctly displayed by the browser. The establishment of common practices and the strengthening of the Web-standards offers to the pole of the developers common techniques as well as justified reasoning to put pressure on the pole of browser manufacturers demanding standards-compliant displaying software. In addition, a side-effect of the extended use of platforms and the read/write Web in general is the fact that the role of the web developer and the content provider become much more distinct than before; nowadays one may consider as Web developers the programmers who develop content management systems of any kind (e.g. e-learning platforms, dynamic websites with administration areas, blogging software and the like), whereas the Web authors are the ones who actually provide the content. It is self-evident that the former are quite fewer than the latter –one would only have to consider the number of blogging software packages compared to the number of bloggers. This side-effect again further supports our argument since it is much easier for small groups to establish and adhere to common practices.

Following the above line of thinking and taking into consideration the fact that e-learning platforms are characteristic examples of content management systems, we conclude that the implementation of the standards to Web-based e-learning software is an easily achievable task, which only requires the will of the community of developers.

E-learning platforms are widely used by students of all levels and may be thought as educative material in their own respect, at least as far as the use of Web-based applications are concerned. Besides this special aspect of e-learning platforms, the benefits of Web-standards compliant software are common to all applications used for content delivery via the Web and set the basis for increased usability and accessibility which remain an open request for the Web community.

#### **4. Cases and solutions by example**

Following the theoretical discussion we provide typical examples of errors encountered during validity checks against the W3C markup and stylesheet validators. This section does not intend to be the equivalent of a quantitative research, neither an exhaustive list of validation errors. It provides however adequate data which support our main conclusion: Web-standards compliance in the case of open source e-learning platforms is an easily achievable objective and a worth targeting one.

In order to select the examples demonstrated below we checked several software packages based on the long list of open source e-learning platforms provided by Edutech (2008) for CSS and markup validity. For the tests we used the demo installations provided by the software developers in their own websites.

(Since most of the platforms use sessions and/or cookies for the login functionality, the validators could not directly access the source of the inner pages. Therefore we downloaded the markup code and uploaded it as an HTML file to the validator. Accordingly, the readers who would like to reproduce our tests and results would have to login to each platform, view the source of the page under examination, save it and then upload it to the validator).

##### **4.1 Markup**

Regarding Web-standards the markup code is the most essential part since it concerns the structure of the hypertext and, consequently, the ability to apply transformations and display the content in different environments. With respect to the origin of the errors, the side of the developers who provide the original code holds responsibility in most cases. In this particular testing we consider the administrators who install the platform to be on the same side with the developers, since we examine demo installations provided by the developers of the platform, but the reader should keep in mind that errors in the markup code may result from modifications by the administrator in each particular installation. Finally a special note should be added for the side of end-users who provide the content. Most e-learning platforms allow end-users to write markup code directly in the forms and, in addition, provide rich text editors in order to facilitate formatting. The validity of the markup in this case depends on the level of knowledge of each user, or –in the usual case– is directly related to the support for standards provided by the rich text editors. Usually written in JavaScript, rich text editors

are standalone WYSIWYG applications which are embedded in a webpage and mimic the interface and functionality of desktop text processors. It is true that during the recent years the support for standards in the case of the most widely used in e-learning platforms rich text editors has improved a lot; still, the situation remains tricky for the inexperienced user, due to the fact that rich text editors are written in client-side scripting languages and therefore rely to the browser for their functionality.

#### 4.1.1 ATutor platform – [course] – file storage page

- Error code in line 435:

```
<div align="center" id="lang" style="clear: left"><br /><form method="get"
action="/atutor/demo/file_storage/index.php?"><label for="lang"
style="display:none;">Translate to: </label><select name="lang" id="lang">
Duplicate value for identifier.
```

Solution:

to use unique values for each identifier, e.g.

```
<div align="center" id="lang_unique_id" style="clear: left">
```

#### 4.1.2 Claroline platform – [course] – learning path page

- Error code in line 4:

```
<html>
```

Missing XML namespace attribute.

Solution:

to reference the namespace, e.g. for XHTML

```
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">
```

- Error code in line 176:

```
<a id="CLDSC"class="item"
href="/claroline/course_description/index.php?cidReset=true&cidReq=101ECON"
>
```

Unencoded entity.

Solution:

to encode all entities. Since this is a common error various techniques already exist. For example PHP coders may use functions like htmlentities() to properly encode strings which contain markup entities. The valid code for this example would be:

```
<a id="CLDSC"class="item"
href="/claroline/course_description/index.php?cidReset=true&cidReq=101E
CON">
```

#### 4.1.3 Dokeos platform – [course] – agenda page

- Error code in line 248:

```
</tr><tr class="row_even"><tr class='row_even'><td colspan="2">
```

Improperly nested elements.

Solution:

keep elements entirely within their containing elements and make sure they do not overlap, e.g.

```
</tr><tr class="row_even"><td colspan="2">
```

#### 4.1.4 Moodle platform – [course] – Tech&Pedagogy page

- Error code in line 426:

```

```

Missing required attribute, in this case the “alt” attribute which is fundamental regarding accessibility.

Solution:

include all required attributes, e.g.

```

```

#### 4.1.5 User submitted content – rich text editor: TinyMCE

The following code was generated by submitting a post in Claroline’s forum, using the TinyMCE editor which has support for the standards. The testing user first wrote the “test” string, then hit “enter” to

create a new line and inserted a table with one row and two columns. The generated code was the following:

```
<p>Test .</p>
<p>
<table border="0">
<tbody>
<tr>
<td>TR1-C1</td>
<td>TR1-C2</td>
</tr>
</tbody>
</table>
</p>
```

The error concerns the nesting of the table within the paragraph element which is generated by the hit of the “enter” key and may be avoided by deleting the containing paragraph; such editing, however, should not be expected by content submitting users. We stress the fact that the rich text editor under discussion in its latest version supports the standards, but this is not always the case.

(This list of examples could be quite longer; instead we kept it as short as possible by providing only typical examples of each category by origin –i.e. developers/administrators and end-users– and of types of common errors –i.e. structural format, document type definitions and entity references–. The main objective of the list of examples is to support our core argument according to which minor syntax errors which produce non-standard code may result to more serious problems regarding the usability, accessibility and interoperability of e-learning platforms).

## 4.2 Stylesheets

We consider stylesheets less important with respect to Web standards due to the fact that they affect only the presentational layer and not the functionality. As far as validation is concerned it is worth noting that we have a significantly lower degree of failures. This result may be explained by two factors: a) the simplicity of stylesheet syntax and b) the fact that style directives are kept in separate files making a lot easier both the maintenance and the testing. With respect to the origin of the errors again the side of the developers is the one who plays a prominent role by providing the original stylesheets; contrary to markup, the end-users vary rarely edit the stylesheets, thus eliminating the cases in which validation errors may be attributed to them, whereas it is more common for administrators who install the applications to modify the stylesheets in order to customize the “look-and-feel” of the platform, thus being prone to syntax errors.

The following examples originate from the stylesheets attached to the demo installations of e-learning platforms and all concern the side of the developers. In most cases the stylesheets were valid which is indeed an optimistic result.

### 4.2.1 Dokeos platform – print stylesheet

- Error code in line 1383:

```
margin: 0 10;
```

Missing the units after the width value.

Solution:

to add the units, e.g.

```
margin: 0 10px;
```

- Error code in lines 532 and 548:

```
#toolnav { float: right; width: 180px; padding: 0; margin: 0;
margin-left: -5%; /* the difference to make the left column appear flush
left */
}
*/
```

Wrong closing of the comments.

Solution:

```
to remove the second closing and to place the closing bracket outside of the comment, e.g.  
#toolnav { float: right; width: 180px; padding: 0; margin: 0;  
  margin-left: -5%; } /* the difference to make the left colum appear flush  
left */
```

#### 4.2.2 Sakai platform – media stylesheet

- Error code in line 2:

```
ul.makeMenu li { /* the behaviour to mimic the li:hover rules in IE 5+ */  
  behavior: url( ../scripts/IEmen.htc );  
}
```

Behavior property does not exist in the standard.

Solution:

not to use browser-specific directives. The same (or very similar) effect may be achieved by accessing the element via the Document Object Model which is a standard technology.

### 5. Conclusions and further steps

Keeping pace with Web-standards is the first and most important step in order to ensure increased usability, high accessibility and the universality of Web applications. Though by no means a compliant website should be considered a perfect one, still it is far more usable than a non-standard one. This conclusion becomes more imperative in the case of e-learning platforms, due to the fact that they are increasingly an inherent part of the educational procedure.

As argued above, the read/write Web as utilized by applications such as e-learning platforms, strengthens the power of Web developers in terms of control over the final code which is sent to the browser. Minor markup and styling code mistakes in the original source of the platform may lead to failures in terms of validity checks, whereas a carefully coded application will always produce valid hypertexts; the wider the usage of the platform, the greater the benefits for the whole community. On the other hand, end-users, especially the ones that are not familiar with markup coding have little to none power to formulate their content in a valid manner. Hopefully the state-of-the-art rich text editors tend to produce valid markup.

Therefore, the pole of platforms developers who create e-learning platforms arises as the critical one in order to reach the goal of Web-standards compliant tools, much more than the administrators or the end-users. The dynamic engine of learning management systems multiplies every minor error resulting in validity failures, but on the other hand, it may ensure that to a large extent the hypertextual content will remain valid if the script generates valid code in the first place. Once again empirical data, as well as claims of conformance by the vendors, indicate that the segment of web-based e-learning software industry moves towards a standards-friendly direction which nonetheless is an optimistic conclusion. Further steps with respect to the issue under discussion include academic advocacy in favor of Web-standards compliance in theoretical level; at the same time, in practical level, detailed and in depth evaluation of each platform against validity checks should be performed by its developers. Quantitative research in the same direction as the example cases examined above might be of some help in order to provide statistical data as to the extent of the problem, but intuitively we believe that this is not a matter of percentages but rather a Boolean respect/disrespect the standards issue. Even more than this, as the example cases clearly indicate, it is an issue of disruption from the side of the coders who respect the standards, write functional and complex scripting code, but neglect to close a tag here and there, or misspell capitalization; much like impatient authors neglected to cross the Ts and dot the Is in the old days of handwriting...

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