Usability Evaluation of Learning Object Indexation: The ARIADNE Experience

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Abstract: This paper investigates usability problems of indexation tools for Learning Objects. Such tools are used to describe and deploy learning objects with their metadata in Learning Object Repositories (LOR's). Metadata is provided to facilitate the search and management of learning objects. The complexity of manually indexing learning objects results in a bottleneck for the introduction of such objects (Duval and Hodgins, 2003), (Kabel, et al., 2003). In this paper, we present the results of a usability evaluation aimed at determining some usability issues in two ARIADNE indexation tools. Results show that metadata semantics is significantly influenced by usability perspectives (such as the user interface, functionalities provided, domain knowledge, etc). The findings and recommendations of this study are generalised for other indexation tools.

Keywords: Metadata, User Studies, Learning Object Indexation, Learning Objects

1. Introduction

In recent years, a lot of attention has been given to the development of tools that facilitate indexation and retrieval of learning materials (learning objects) in Learning Object Repositories (LOR's) (Duval and Hodgins, 2003), such as (Ariadne, 2004), (Merlot, 2004) and (SMETE, 2004). However, little attention has been given to the usability evaluation of these developed tools (Duval and Hodgins, 2003). This evaluation will help researchers to determine to what extent indexation tools enable users to reach their goals effectively and efficiently (Jones, et al., 1998), (Marchionini, et al., 2000). In addition to this, it will help us to determine users' satisfaction on the overall use of the evaluated tools. Furthermore, usability evaluation for indexation tools allows us to understand how real users interact with such tools. For example, we can obtain the average time needed to perform a particular task, the level of satisfaction, and the ease of use of the indexation tool. Hereby, findings and recommendations obtained from such usability evaluations help to improve the indexation of learning objects.

Several usability studies have been made in the context of Internet browsing (Cockburn and McKenzie, 2000) (Nielsen, 2004), digital libraries (Jones, et al., 1998) and other computer applications. On the other hand, this issue has not been studied intensively yet in the context of LORs (Duval and Hodgins, 2003). In a previous work (Najjar, et al., 2003) we investigated the behavior of users who index relevant learning objects in the KPS, by analysing the usage logs. In this paper, we show results of the usability evaluation applied to two Ariadne indexation tools (SILO and Toledo, see section 2). Both tools are deployed to the Ariadne Knowledge Pool System (KPS).

Results of this study show that indexation of learning objects may be influenced by different usability perspectives. Firstly, interface of indexation tools. Secondly, functionalities provided to facilitate the indexation process, such as automatic indexation. Thirdly, indexer domain knowledge about the introduced learning objects. In order to collect high quality metadata for learning objects, we provide the following recommendations. First, the user interface of indexation tools should be simple and adapted to the user, not to the metadata standard used by the LOR. Second, functionalities such as automatic indexation are helpful and it should use intelligent techniques to extract metadata of high quality.
The paper is structured as follows: in section 2, the two evaluated Ariadne clients are introduced. Methods and procedures for the usability evaluation are introduced in section 3. In section 4, the results obtained from the study are presented. Discussion on the results is given in section 5. Finally, conclusions and future work are given in section 6.

2. Ariadne clients

Ariadne (ARIADNE, 2004) is a European project started in the year 1996. It is an integrated E-Learning environment, incorporating a Knowledge Pool System (KPS), a web-based course environment and a number of content authoring tools. The KPS is a Learning Object Repository (LOR), similar to (Merlot, 2004), (SMETE, 2004), etc. The main goal of Ariadne is to foster the share and reuse of learning objects. In order to achieve that goal an Indexation- and Query tool has been developed to enable users’ index and search relevant learning objects in the KPS.

The indexation- and query tool uses 47 metadata elements to describe learning objects, from which 18 are mandatory (Neven, et al., 2003). The metadata elements form what is called a metadata Application Profile of the IEEE Learning Object Metadata (LOM) standard (IEEE, 2002). An early version of Ariadne metadata elements in conjunction with the IMS (IMS, 2004) elements set formed the backbone of the IEEE LOM.

2.1 SILO client

Figure 1 shows the current version of the Indexation- and Query tool which is called SILO (Search and Index Learning Objects). SILO is proposed to enhance the indexation and search procedures in the Ariadne KPS by providing a number of functionalities (search functionalities are not relevant for this paper):

- A profile (template) of metadata elements: elements provided for this profile are automatically presented to the user when inserting new learning objects.
- Automatic Indexation: a number of metadata elements are automatically extracted from the learning object itself. For example, the document title, file name, required disk space, MIME type, etc. are automatically presented to indexers.

![Figure 1: Screenshot of SILO indexation client](image)

2.2 Toledo client

Figure 2 shows the evaluated version of Toledo client. Toledo is an Ariadne building-block for Blackboard e-Learning management system. Toledo is used in K.U.Leuven University to introduce learning objects to the Ariadne KPS. Toledo is different from SILO in the following issues:

- Toledo has a different look-and-feel than SILO.
- More elements are automatically indexed in Toledo than SILO does (based on the narrow context, see next point).
- Toledo is used only in the context of K.U.Leuven. Only K.U.Leuven instructors are able to introduce or search learning objects using it. SILO is of more general context. Users from different institutions and countries, also, of different education levels can use it.
3. Methods and procedures

3.1 Participants and tasks

A usability test was performed on the two Ariadne indexation clients; SILO and Toledo. We collected detailed data from extended sessions with seven users. Participants were selected to be representative of intended user community, including university professors, research assistants, and university students (see table 1). The goal of the usability test was to cover a wide range of abilities and sophistications, not to constitute a statistically balanced sample. Because the aim of this study is to determine whether such clients help target users to achieve their goals and discover problems that may influence users’ effectiveness, efficiency and satisfaction.

We started each test session by introducing participants to the process, and generally put them at ease, that it was the system to being evaluated, not he or she and that his feedback will help us improve the usability of the clients. No instructions were given for SILO or Toledo, since we wanted to discover whether the clients were usable by the novice users. This is because many users who may index or search learning objects probably are inexperienced with such tools (a kind of ‘worst case’ is created).

The seven participants were conducted separately, during each test session, a participant was asked to use SILO and Toledo to perform a number of task scenarios (see table 2) and to think aloud while carrying them out. Remark, two participants among the five who tested both clients SILO and Toledo started the test session by testing Toledo then SILO. At the end of each session, each participant was asked to fill in a feedback questionnaire on the overall use of the clients. An experimenter was present in the test room throughout the session to provide any assistance solicited and to observe participants behaviour. Videotaping and screen recording were applied to observe user interaction during test sessions.

Videotapes, screen recordings and paper notes were compiled, analysed and findings were sent to the development teams of both clients for improvements.

Table 1: Profile of usability test participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>Sex</th>
<th>Age</th>
<th>Job Title</th>
<th>Field</th>
<th>Computer Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>M</td>
<td>30-39</td>
<td>Research Assistant</td>
<td>Electrical Engineering</td>
<td>High</td>
</tr>
<tr>
<td>P2</td>
<td>M</td>
<td>30-39</td>
<td>University Professor</td>
<td>Medical Sciences</td>
<td>Medium</td>
</tr>
<tr>
<td>P3</td>
<td>F</td>
<td>40-49</td>
<td>Master Student</td>
<td>Information and Library sciences</td>
<td>High</td>
</tr>
<tr>
<td>P4</td>
<td>F</td>
<td>20-29</td>
<td>Undergraduate Student</td>
<td>Physiotherapy</td>
<td>Medium</td>
</tr>
<tr>
<td>P5</td>
<td>F</td>
<td>20-29</td>
<td>Research Assistant</td>
<td>Medical Science</td>
<td>Medium</td>
</tr>
<tr>
<td>P6</td>
<td>F</td>
<td>30-39</td>
<td>University Professor</td>
<td>English Literature</td>
<td>Medium</td>
</tr>
<tr>
<td>P7</td>
<td>M</td>
<td>30-39</td>
<td>Research Assistant</td>
<td>Computer Science</td>
<td>Very High</td>
</tr>
</tbody>
</table>

Table 2: List of tasks assigned to participants in the usability test

<table>
<thead>
<tr>
<th>Tasks performed on SILO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1: Introduce new learning object to Ariadne KPS</td>
</tr>
<tr>
<td>Task 2: Update user profile (a template contains a set of data elements)</td>
</tr>
<tr>
<td>Task 3: Insert new learning object after updating user profile</td>
</tr>
</tbody>
</table>
In order to be as close as possible to the real context of participants when performing their daily work, participants were asked to introduce to the KPS, two pre-selected learning objects (for example PDF, PowerPoint files) such as materials used by them for learning or training purposes. Each participant was given around 45 minutes to finish her/his set of tasks.

3.2 Measurements

In this section we discuss principles that have been investigated and techniques used to measure them.

1 Performance, four issues related to this principle were measured:
   a Task success rates.
   b Time needed to finish each task.
   c Number of errors; such as wrong menu choices, wrong selections.

2 Observed User behaviour, which helps us to understand user interaction and may be detecting some usage patterns. This issue was observed by screen recording and videotaping.

3 Satisfaction, user satisfaction was obtained through a questionnaire filled in by each participant after finishing the test tasks. Questionnaire questions intended to measure user overall satisfaction on the usage of the clients. The popular attitude scale with seven points was used in the questionnaire (see figure 3).

4 Kind and quality of metadata, evaluate provided metadata information which help to determine factors that influence the indexation process.

Table 3: attitude scale used in questionnaire to measure participant satisfaction.

<table>
<thead>
<tr>
<th>Poor</th>
<th>Unsatisfactory</th>
<th>Neutral</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

4. Results

4.1 Performance measures

4.1.1 SILO client

As shown in table 3, seven participants were asked to perform three tasks on SILO client. Six participants (86%) were able to finish the three tasks successfully; two participants (29%) finished the first task without any assist from the facilitator, six participants (86%) in the second task and five participants (70%) in the third task. Remark, one participant could not complete the two tasks (task1, task3) related to the insertion of learning objects because of a system bug (SILO is a prototype version and some bugs might be discovered during the test).

Table 3: Participants performance in SILO and Toledo

<table>
<thead>
<tr>
<th>Client</th>
<th>Task</th>
<th>Completion rate W/T assist</th>
<th>Completion rate with assist</th>
<th>Mean time (min)</th>
<th>Mean errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>SILO N=7</td>
<td>Insert new learning object 29%</td>
<td>86% (1)</td>
<td>15.4</td>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Update user profile    86%</td>
<td>86 % (2)</td>
<td>4.8</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insert 2nd learning object 70%</td>
<td>86% (1)</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Toledo N=5</td>
<td>Insert new learning object 80%</td>
<td>100%</td>
<td>9</td>
<td>0.8</td>
<td></td>
</tr>
</tbody>
</table>

(1) One participant was not able to finish task successfully because of a system bug.
(2) One user wasn’t able to find the link to access the user profile, and then went to the next task.
* The same learning object is inserted in SILO and Toledo

For the mean time needed to complete each of the tasks, 15.4 minutes (SD=5.48) was needed to insert new learning object for the first time, 4.8 minutes (SD=2.98) was needed to update a user profile, and 3 minutes (SD=0.98) was needed to insert a second learning object (values provided by users for user profile were provided automatically).
For the number of errors countered during users’ sessions while testing SILO, a mean of 1.6 (SD=0.84) errors were countered when inserting a new learning object and 1 error (SD=1.10) when inserting a second object.

4.1.2 Toledo client

As shown in table 3, five participants were asked to perform one task with Toledo. The five participants (100%) were able to complete the task assigned to them successfully; four of them (80%) were able to complete the task without any assist from the facilitator.

The mean time to complete the task of inserting a new learning object with Toledo was 9 minutes (SD=8). The mean for the number of errors occurred while performing the task was 0.8 errors (SD=0.84).

As can be noticed from the performance results of the two clients, task completion rate and time needed to insert a new learning object in Toledo are higher than SILO. We believe that this is related to the fact that Toledo shows less metadata elements to be filled in by users, and more metadata elements are filled in automatically in Toledo than SILO. Moreover, the success rate for inserting the 2nd learning object in SILO was increased to more than the double compared to the rate of inserting the first object. Also, the mean time to insert a second object was decreased from 15.4 to 3 minutes. This is related to three reasons. First, when users introduce a second object they are more used to the tool. Second, more metadata information are provided automatically. Finally, we noticed that users filled in only mandatory elements when inserting a second learning object.

Moreover, we noticed that users who started the test session by inserting a learning object using Toledo needed less time to insert the same object using SILO and vice versa. That is related to the fact that participants insert an object using any of the clients, they become more familiar with the indexation process. Clearly, they better understand the idea behind providing metadata information of learning objects, and they better understand the meanings of metadata elements and their associated vocabularies.

4.2 Observed behaviour

Based on participants thinking-aloud and screen recording, a set of usability problems were identified in both SILO and Toledo clients:

- Lack to plain help text, lack to necessary information that may tell users what such clients are used for and what steps to be done by users to successfully perform the different tasks.
- Navigation problems, lack-to or existence-of redundant navigation components. For example, “remove” button was not provided for some functions or providing unnecessary “next” buttons.
- Lack to purposely clear feedback, un-understandable feedback was provided in case of incorrect actions, or missing of required information, etc. Feedback messages that guide users to correct them selves whenever errors occurred are vital.
- Extreme use of technical jargon, use of technical terms as labels for action buttons. For example, use of “add”, “insert” terms in places that are ambiguous to user.
- Unfamiliar metadata terms, some metadata labels were not obvious to the users.
- Much information is to be provided by the user, long list of metadata elements to be filled in by users when introducing new learning objects to the KPS, or when updating user profiles.

As can be seen in the above usability problems, the first four are typical usability problems. While, the last two are more indexation (Metadata) related problems. Such problems either made participants perform incorrect actions or made participants feel frustrated. Also, those problems increased users need to ask for help functions or facilitator help. We believe that the above-mentioned usability problems are also available in other indexation tools used in different LORs. Specially, the last problem where indexers have to provide lots of metadata information when introducing learning materials to learning management systems.
4.3 Satisfaction

Table 4 presents participants’ response to questionnaire questions about overall use of SILO and Toledo. The mean for level of difficulty, information organisation, use of terminology and quality of feedback was perceived a bit around moderate (around 4) in both clients. The mean for level of navigation, indexation performance (uploading material and providing metadata information) was in acceptable level (around 5). Interestingly, participants found that default values provided by Toledo (mean was 5.8) and SILO (mean was 5.4) are helpful and reliable. Participants were also relatively satisfied (mean was 5) about the usage of the user profile function in SILO. Important Remark, participants found the feature of having a user profile interesting, while most of those users found it not easy to understand the purpose of such profile. Moreover, we noticed that participants filled in little information for few metadata elements at the general information panel when updated user profiles. This may be related to the fact that SILO profile function presents users with a long list of metadata elements, which made the users feel overwhelmed.

Table 4: User satisfaction on the overall evaluation

<table>
<thead>
<tr>
<th>Principle</th>
<th>Mean SILO(1)</th>
<th>SD SILO(2)</th>
<th>Mean Toledo</th>
<th>SD Toledo</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ease of use</td>
<td>3.9</td>
<td>1.86</td>
<td>4.6</td>
<td>1.81</td>
</tr>
<tr>
<td>2. Is Fast (response time)</td>
<td>5</td>
<td>1.63</td>
<td>5.2</td>
<td>1.48</td>
</tr>
<tr>
<td>3. Information organisation</td>
<td>4.4</td>
<td>1.71</td>
<td>4.4</td>
<td>2.12</td>
</tr>
<tr>
<td>4. Use of terminology</td>
<td>4</td>
<td>1.29</td>
<td>4.2</td>
<td>1.09</td>
</tr>
<tr>
<td>5. Quality of feedback</td>
<td>4.2</td>
<td>2.13</td>
<td>4.2</td>
<td>2.34</td>
</tr>
<tr>
<td>6. Navigation</td>
<td>5.6</td>
<td>1.13</td>
<td>5.2</td>
<td>1.10</td>
</tr>
<tr>
<td>7. Indexation performance</td>
<td>4.9</td>
<td>1.86</td>
<td>5.2</td>
<td>1.48</td>
</tr>
<tr>
<td>8. Profile usage (3)</td>
<td>5</td>
<td>1.86</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>9. Default values</td>
<td>5.4</td>
<td>2</td>
<td>5.8</td>
<td>0.44</td>
</tr>
<tr>
<td>Mean</td>
<td>4.7</td>
<td>4.24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: (1) n = 7, (2) n = 5, (3) In Toledo this function is hidden from users.

From the data shown in table 4, we notice that users were kind of moderate about the overall use of both clients. We think that user satisfaction may be increased by, firstly, solving usability problems related to information organisation, use of terminology and feedback. Secondly, increasing the user motivation, by decreasing the number of metadata elements presented to be filled-in by indexers when introducing new learning object or providing profile information. This may be achieved by providing high quality semi-automatic indexation techniques that save users time and effort when introducing new learning objects to the KPS.

4.4 Usage and semantics of metadata

In this section we discuss issues related to the usage of metadata elements and its associated semantics. We compare kind and quality of information provided by participants to describe learning objects in both SILO and Toledo clients.

As shown in table 5, data provided to describe learning objects in Toledo is of higher quality than SILO. Remark, the 1st learning object introduced to SILO by each participant is also introduced to Toledo. However, in SILO, we notice that the number of errors for introducing the 1st learning object is closed to the number of errors when introducing the second object. Moreover, participants started their sessions by inserting a learning object using Toledo provide more incorrect values than they did when they inserted the same object using SILO (1st learning object in SILO). This may be related to two reasons:

- Organisation of metadata elements in Toledo, by some means, is better than in SILO. For example, some participants filled in the correct value for “title” of learning object in the field that is provided to specify the “source” of the indexed learning object if needed.
- Automatically provided data, we noticed that most incorrect values were provided for title data element, which its value is automatically generated from the filename of a digital file. However, few users give meaningful filename for their digital files. Therefore, when participants introduce such file to the KPS, the title value will not be semantically correct if not edited manually by participants. As one solution to this problem, it is more efficient to
extract the title value from within the document itself when ever possible, for example, using text recognition techniques.

**Table 5: Metadata usage and semantics**

<table>
<thead>
<tr>
<th></th>
<th>SILO 1st inserted LO</th>
<th>Toledo 1st LO</th>
<th>SILO 2nd inserted LO</th>
<th>Toledo 2nd LO</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. (1)</td>
<td>incorrect values</td>
<td>No. (2)</td>
<td>Metadata Quality</td>
<td>No. (2)</td>
</tr>
<tr>
<td></td>
<td>optional elements</td>
<td>incorrect</td>
<td></td>
<td>optional</td>
</tr>
<tr>
<td></td>
<td>values</td>
<td>elements</td>
<td></td>
<td>elements</td>
</tr>
<tr>
<td>Par1 4</td>
<td>6</td>
<td>Medium 1</td>
<td>Medium 0</td>
<td>High</td>
</tr>
<tr>
<td>Par2 1</td>
<td>3</td>
<td>Medium 3</td>
<td>Poor NA</td>
<td>NA NA</td>
</tr>
<tr>
<td>Par3 2</td>
<td>6</td>
<td>Medium 3</td>
<td>Medium 1</td>
<td>High</td>
</tr>
<tr>
<td>Par4 2</td>
<td>0</td>
<td>Medium 3</td>
<td>Medium NA</td>
<td>NA NA</td>
</tr>
<tr>
<td>Par5 0</td>
<td>2</td>
<td>High 3</td>
<td>Medium 1</td>
<td>Medium</td>
</tr>
<tr>
<td>Par6@1 6</td>
<td>5</td>
<td>Medium 1</td>
<td>Medium 0</td>
<td>High</td>
</tr>
<tr>
<td>Par7@3 0</td>
<td>Medium 3</td>
<td>0</td>
<td>Poor 1</td>
<td>High</td>
</tr>
<tr>
<td>Mean 1.9</td>
<td>2.9</td>
<td>1</td>
<td>1.3</td>
<td>0.8 1</td>
</tr>
</tbody>
</table>

*Note: (1) Less is better, (2) More is better, * The same learning object, @ Participant started the test session by Toledo Then SILO

As noticed in table 5, participants used more optional data elements in SILO than in Toledo. However, we noticed that the only optional data element used by all participants in Toledo is “Description” data element. Moreover, all participants provided correct values for it. While, the same element was only used by one participant in SILO and an incorrect value was provided for it. We think this is related to the place of this element in both clients. In Toledo it is placed at the second place of the list after title data element; also all participants provided correct values for title element in Toledo. On the other hand, SILO presents Description element at the button of a long list of metadata elements of general information panel.

From the above discussion we notice that the interface of indexation tools may significantly affect semantics of information provided to describe learning objects. Moreover, manual indexation of learning objects may also affect the semantics of such metadata. Specially, when users are presented with many data elements to be filled in, or when users have little experience about topic or context of learning objects. Therefore, more efficient automatic indexation techniques should be considered. Also, user interface of indexation tools should be simpler to save users time and effort as well as metadata semantics.

**5. Discussion**

The goal of this study was not only to discover and solve usability problems that might appear in the Ariadne indexation clients, but also to address factors that may improve the indexation process. Also, increase the quality of metadata information provided for learning objects. In other words, we wanted to determine factors that may:

- Enrich the semantics of provided metadata.
- Decrease user dissatisfaction on the overall use of indexation clients.
- Increase user satisfaction on the overall use of indexation clients.

Findings and recommendations presented in the forthcoming sections should also be helpful to improve similar indexation tools used in other LORs.

This section is divided into three parts. In the first part, we classify usability problems that may affect the semantics of metadata. In the second part, we present factors that may help to decrease user frustration and dissatisfaction when using indexation clients. In the third part, we present factors that may increase user motivation and satisfaction.

**5.1 Usability perspectives that influence the semantics of metadata**

Based on the findings presented in section 4.4, we found that metadata semantics may be significantly influenced by one or more of the following usability perspectives:

- User interface of indexation tools: for example: poor use of terminology as well as organisation of metadata elements and its associated vocabulary values may make indexers fill in inappropriate metadata information.
Functionalities provided: for example, incorrect values provided by automatic indexation technique or improper use of user profiles may, also, affect the quality of metadata.

Domain knowledge: indexers with a limited knowledge about learning objects they introduce will also affect the semantics of metadata. A proper presentation for all of the above mentioned usability perspectives should enriches the semantics of metadata information. Therefore, user interface should be simple and easy to use. Functionalities provided should be as intelligent as possible. Domain knowledge is a high subjective aspect, but advanced technologies may help to provide rich metadata. For example, ontologies (Verbert and Duval, 2004) or text recognition techniques may be used to add or correct metadata information.

5.2 Decrease user frustration and dissatisfaction

As we noticed from participants’ performance results and feedback, participants were kind of moderate about the overall use of the tested clients. We believe that participants’ dissatisfaction with the clients may be decreased to accepted levels, by solving usability problems related to clients interface. Therefore, the following modifications (improvements) should be integrated into the clients.

An indexation and query client should start with a page that introduces the users to the tool. This page is considered necessary to provide users with general information about the client (such as what is the tool used for). For example, currently, when users arrive at SILO they are introduced with plain page of three form fields that allow users to login to the client. Also, when users login to the client they are introduced by a simple search menu. We think overall information will be helpful for novice users to understand better what such clients are used for and what tasks can be performed.

Links to main functions should be more obvious: such links should have clear labelling and located at easily reachable place on the screen. Therefore, Links to main functions such as insert learning object, simple search, advanced search, user profile should be obvious to users. For example, in SILO links to "Insert" and "Profile" functions that are located at the right upper part of the screen, may be changed to "contribute learning object", "update usage profile" respectively. Also should be located at the left upper part of the screen; looking at left part is more common for western people, right part is more obvious for eastern people (such as Arabic or Hebrew natives; Ariadne tools serve the European community).

Clear and on purpose feedback should be provided to users’ when performing incorrect actions. For example, when users submit a metadata form without providing mandatory fields, they should be provided with an obvious feedback message. Also, it’s vital to provide clear instructions that may guide the user correct him self when ever needed.

Redundant navigation components should be avoided. For example, in SILO, “next” button at the last menu tab is not needed; such components are seen as redundant and also confusing to the user.

Terminology, captions of metadata elements should be obvious to novice users (users who don’t grasp much information about metadata); in most clients captions of metadata elements and associated vocabularies are copied from metadata standards such as LOM (IEEE, 2002) or Dublin Core (Dublin Core, 2004). Therefore, help notes that may provide users with the meaning of such elements and vocabularies are vital. That does not mean to provide help notes for all elements, but to provide such note when ever needed (for unobvious elements). Because indexers may provide incorrect (or neutral) information for elements they may not understand their meanings.

We think that integrating the above mentioned factors to the interface of indexation clients decreases users’ dissatisfaction and frustration with the tools. However, that does not guarantee that users will be satisfied with the use of such clients! In the next section we discuss other factors that may increase user motivation and satisfaction when using indexation clients. Remark, if users are not dissatisfied it does not mean that they are satisfied.
5.3 Increase user motivation and satisfaction

In the previous section we discussed a number of factors that may decrease users’ frustration and dissatisfaction. In this section we present factors that may increase users’ motivation and satisfaction with indexation clients.

Hopefully, imagine that all earlier mentioned usability problems (typical usability problems) have been removed. That means, users receive useful feedback, use of terminology is obvious, and users can easily navigate within components of the clients, etc. On the other hand, users still have to fill in a large number of metadata elements when introducing new learning object or when updating the user profile. Do you think that users’ motivation and satisfaction will be significantly increased? Our answer is no! Because users are still required to provide a large number of information when introducing new learning object or updating the user profile.

Based on the videotaping of the users interaction when tested SILO, we noticed that users submit metadata records after providing values for elements of the first menu panel (SILO has four menu panels grouping four sets of related metadata elements). Then, users start to fill in mandatory metadata elements after they receive the form back with mandatory elements only. This shows that users feel frustrated after or while filling the first set of metadata elements needed to introduce new learning object to the KPS.

We think that users’ motivation and performance might be increased by integrating the following factors into SILO client:

- **Personalisation**, earlier studies in the field of HCI have shown that users prefer that a client gathers their preference information automatically, than asking them to provide such information every time they visit the client. In the case of indexation clients, asking users to fill in a large number of metadata elements when visiting such clients will probably make users more frustrated and decrease their motivation to use the client. Therefore, clients should automatically provide users with their personal information (information that rarely changed) when login to the client. Also, users should be able to change such information when ever necessary.

- **Semiautomatic indexation**, based on users observations and feedback, we noticed that participants’ performance and satisfaction in Toledo were higher than SILO. That is related to the fact that, Toledo has less metadata elements to be filled in manually by users. Toledo automates more values for data elements than SILO does, based on the context (narrow) of Toledo. Therefore, the number of metadata elements to be manually filled in should be decreased as much as possible in SILO. This can be achieved by hiding metadata elements that are rarely used by users (Najjar, et al., 2003). Also, by introducing new algorithms that may help to provide values automatically for other metadata elements. For example, algorithms that generate automatic values based on, for example, empirical analysis of actual usage, text or image recognition techniques or ontologies. In order to save the quality of metadata semantics, we may allow users to change automatically provided information when ever necessary.

By doing so, users only need to provide or check values for few metadata elements, when introducing a new learning object to the KPS or updating a user profile. Hereby, user effort and time have been saved, which increase users motivation and satisfaction to introduce learning material to LORs.

6. Conclusions and future work

In this paper, we investigated usability problems of indexation tools for learning objects. Such tools should help provide semantically rich metadata for learning objects. Usability problems may significantly influence the semantics of provided metadata whenever it appears in the user interface or functionalities of indexation tools.

We believe that the main problems behind the complexity of the indexation of learning objects are:
User interface of indexation tools in most of LORs are more adapted to the metadata standards and not to the indexer. This is related to misunderstanding of implementing interoperability with metadata standards. For example, in some LORs, terminologies and organisation of metadata elements are copied as it is from documents of metadata standards. While terminologies (labels of metadata elements and vocabulary values) and information organisation should be adapted to the local community of the LOR.

Functionalities provided to facilitate the extraction of metadata are not as intelligent as should be. More advanced techniques should be used to improve the indexation process.

In future work we intend to investigate the usability problems in the evaluated tools after implementing the recommendations of this study into them. Also, apply more advanced evaluation methodologies to investigate the advanced techniques and functionalities provided to facilitate the indexation process.

References

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