Towards a practitioner-centered approach to the design of e-learning competence editors

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Abstract: This article reports on the background research on requirements and current approaches to editors for learning curriculum designers. First we take a critique look at the state of the art in the domain of learning activity editors. We then look back in the information visualization and interaction literature to discuss the design challenged of such tools. From these current theories and applied works we define a set a rules that are crucial for the design of CDP editors based developed on top of complex e-learning models. Finally, we exemplify the set of design rules with a prototype integrating tightly coupled map-based and Gantt chart views.

Keywords: e-learning, user-centered design, learning editors, competence development

1. Introduction

In our largely knowledge-based society there is a growing need for continuing professional development, in order to deal with the evolving character of professional knowledge and technologies. This leads to the creation of curriculums that are not limited to formal learning activities that lead to certificates or degrees, but that also include non-formal learning activities. We define this collection of learning activities as Competence Development Programmes (CDPs) that are aimed at maintaining or increasing the level of a worker's competence are generally. In order to support these activities, a technological infrastructure is required for storing, organizing and sharing the various bodies of knowledge; in addition, this infrastructure should provide lifelong learners with learning objects that fit their individual background knowledge, learning objectives, and other needs. Technological support for learning activities is not a new concept; a substantial amount of research has been carried out in the field of adaptive and intelligent Web-based educational systems (Brusilovsky and Peylo, 2003). However, the broader field of competence development poses several additional challenges and requirements such as the development of positioning, navigation and learning support services. Moreover, tool to support the practitioners who create and maintain CDPs must still be deployed. So far, very little work has be spent on transforming the complexity of learning path model (Koper and Tattersall, 2005) into usable tools for practitioners and learners. This paper proposes to move towards a practitioner-centered approach to the design of e-learning competence editors by first defining clear and intuitive guidelines to meet the challenges

opened by the underlying complexity of e-learning models. Then, we present a prototype that will be used by curriculum designers for positioning their material and for creating tentative learning paths, as well as by curriculum planner (e.g. learner) for planning learning routes.

This article is structured as follow. First we describe previous works in the domain of learning management systems. We compare them with a list a set of requirements for the design of competence editors. Then, we provide a theoretical framework on the challenges in the design of interactive visualization system. From that we define a set of rules that we applied to the design of our prototypical competence development program editor. We believe that these rules can help the development of more user-centered tools for data-rich e-learning environments.

2. Related works

The domain of learning activity editors has been fruitful these past years. We reviewed 3 of the most compelling research works to understand their features and limitations. First, LAMS (Learning Activity Management System)[1] is a system for creating and managing sequences of Learning Activities. Its authoring tool allows teachers to create and modify sequences of learning activities and store these in the sequence repository), and monitoring (where a teacher can select a sequence from the sequence repository, assign a group of learners, activate the sequence for learners, and then monitor their progress). It features a very simple path creation without providing requirements in the relations. Moreover, it disposes to only a limited set of types of activities and resources in its toolkit.

Moodle[2] is a Course management system (CMS) for producing web-based courses. In this platform, a teacher has full control over all settings for a course and its management. He/she has a disposable a flexible array of course activities such as forums, quizzes, glossaries, resources, choices, surveys, assignments, chats, workshops. The learning path is ordered according to the course format by week, by topic or a discussion-focused social format. The social aspect and simplicity of the platform made it very successful.

As part of the RELOAD project (Reload, 2005), Phillip Beauvoir and Paul Sharples of the University of Bolton have developed the Learning Design Editor. It supports the full IMS Learrning Design specifications for Levels A, B and C. In a project manager view, learning planners can organize their Learning Designs. This tool does not carry a very intuitive sense of creating learning path and sequencing activities. It is probably due to its purpose of staying at very close to the IMS-LD complex specifications.

3. Design challenges

The design and use of interactive information visualization tools such as e-learning editors have been widely studies in the past. As advised by (Schneiderrman et al, 2000) visual tools should be designed to be both displays and search tools at the same time.

[1] http://www.lamsinternational.com/
[2] http://www.moodle.org/

Some visual schemes generate only one view per information space, but allow the user to zoom in and out, rotate, or in general change his/her own viewpoint on the image resultant from the visualization. This approach to visualizing information spaces inhibits searching and browsing by making it difficult for users to isolate, identify, and analyze parts or aspects of the information space. Users should be allowed to customize and control the manner that the tool at hands addresses information spaces. Moreover, users should be able to specify which part of the information space to visualize in a dynamic manner, making browsing are re-querying information spaces a process of moving between different views and viewpoints at the same time. The latter approach is not only based on the fact that tools should allow free browsing, but also on the general need of users to identify relations within the information space and between information spaces as well. This engenders the necessity to represent a number of information spaces simultaneously within the same visualization or within a number of independent windows with tiling or any other design choice that developers might commit to answer this need. On the other hand, not all information spaces are complete or closed sets, some of them remain open or dynamic while others suffer from non-rectifiable gaps. Gaps in information spaces should be visualized and made noticeable for the users in order to ease their identification and isolation. Some visualization schemes have chosen to abstract such gaps in favor of the overall presentation or the look of the visual metaphor, but it's rather vital for the study of such gaps that the latter be visualized in relational context with the rest of the information space. Finding what is missing in the information space is as important as finding what is actually there.

4. Interaction design

The efficiency of tools directly derive from the ability of humans to assimilate them and work around them, with these applications and schemes tailored in respect to the human cognitive process and taking account of its limitations and powers designers can hope to maximize their utility. A visualization that overwhelms human sensors will only frustrate its users whom will become largely prompt to erroneous behaviour and discontinuity with the information's context. The failure to take human physiological properties into considerations may strongly be the explanation behind the failure of many complex information schemes to achieve high usability levels.

Interactive visual tools, like the majority of software applications, may be dependent on the human environment in which they are deployed. In some environment, users don't have the time to decipher complex information metaphors designed to represent large information spaces, while in others users may be totally dependent on their interaction with the information application to succeed in their work or quest. In short, understanding the properties of the targeted human environment and how humans behave psychologically in that environment becomes an issue of moderate if not high priority to the designers of visualization schemes and to those developing software application in general. However, being a special type of software, informative applications are not generally built only to cover the users' need for a set of functionalities and are rarely developed to pertain to a closed set of tasks. These applications rather aim at making information spaces accessible and manipulative, and hence shed more importance on understanding the behavior of users within and around the information spaces visualized. Therefore, formulating a good understanding of the users' behaviour around certain sets

of information spaces facility the design of schemes that afford some beneficial actions and inhibit others.

5. Our approach

As discussed earlier, we are challenged to invent powerful information visualization methods, while offering smoother integration of technology with task. This section summarizes our prototype facing this difficult challenge in the context of e-learning. The literature and state of the art review on learning activity editors, information visualization and interaction design revealed the issues we intend to tackle in our prototype. In the context of this work we believe important to follow the information seeking mantra extended with a direct manipulation approach. In consequence, we set rules for visualization and interaction of a CDP editor (Table 1)

Table 1: design rules

Visualization	
Integrated system	Essential tools and views in a single integrated frame to preserve spatial continuity
High interactivity	Immediate feedback for all actions to preserve temporal continuity and to encourage exploration
Different views	Emphasize different aspects and perspectives
Tightly linked views	Changes in one view are reflected in the others
Interaction	
Probing	View more details about a learning object and to get an understanding of the relationships between the different views.
Selecting	to mark objects that are of short-term interest

In consequence we developed a design approach to integrate these rules. We based our solution on the integration of tightly linked views using a map-based visualization and a Gantt chart.

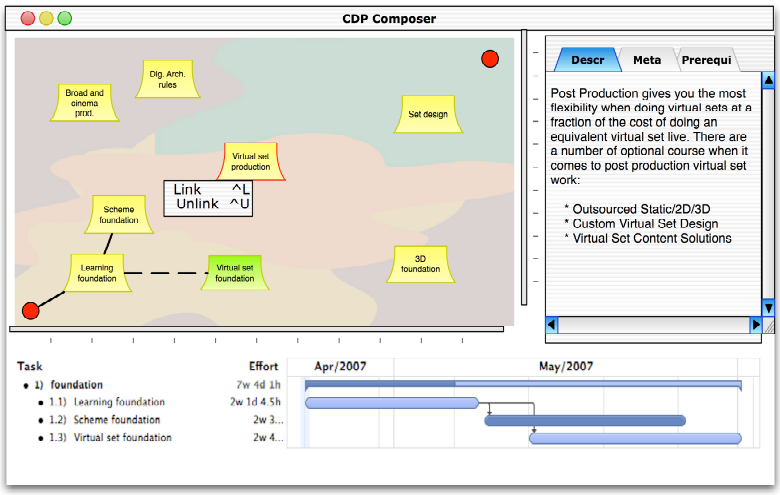

Figure 1: Screenshot of the prototype showing the integration of the tightly coupled map-based and Gantt chart

6. Map-based visualization

This first attempts lacked of strong metaphors to explore and navigation the information contained in a competence development program and a learning path. Therefore, we propose to use of the human sense of orientation to compose and manage Competence Development Programs. The proposition is to use the physical world (maps) metaphor for a learner to browse in a world of competences and learning object. The cities are replaced by learning objects (e.g. modules, courses, programs). The mountains, the roads and the rivers are here thematic and phases, which divide the learning object.

We believe that in two-dimensional information such as maps, users are trying to grasp adjacency or navigate paths, whereas in graph-structured information, users are trying to understand parent/child/sibling relationships. Moreover maps represent what a simple tree structure cannot show and they allow the navigation within the different level of granularity of information.

7. Gantt Chart

A 2-dimensional map do not well render a time scale. On the other hand, Gantt charts are visualization tools to control and administer activities to complete a project. Therefore, we believe it could be well applied to CDP and follow our integrated systems and different views rules defined previously.

Author

8. Conclusion

In summary, our approach uses a first 2D maps visual representation for content navigation and exploration and learning path edition. Second it the representation of the relations in time with the units of learning relies on a basic Gantt chart. The whole information visualization systems is integrated system with high interactivities (contextual on the maps). It uses a well-known metaphor of space to get detailed information on a selected item (unit of learning).

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