A Support for Navigation Path Planning with Adaptive Previewing for Web-based Learning

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Abstract
How to help learners plan a navigation path on the Web is an important issue in web-based learning/education. Our approach to this issue is to allow the learners to preview a sequence of web pages as navigation path plan. In this paper, we introduce an assistant system that enables learners to plan the navigation path in a self-directed way before navigating hyperspace provided by web-based learning resources. It also realizes an adaptive previewing in accordance with their planning context. Since the adaptive previewing gives the learners in advance an overview of the contents to be learned, their learning in the hyperspace can be improved.

1. Introduction
Existing web-based learning resources generally provide learners with hyperspace where they can navigate the web pages in a self-directed way to learn the domain concepts/knowledge. The self-directed navigation involves making a sequence of the pages navigated, which is called navigation path [2]. Making a navigation path is an important process of the self-directed learning in hyperspace [4].

On the other hand, learners often fail in making a navigation path due to a cognitive overload, which is caused by diverse cognitive efforts not only at planning a navigation path but also at setting up global/local learning goals, comprehending the contents navigated, and so on [2, 5]. Although such navigation problem has been a major issue addressed in educational hypermedia/hypertext systems [1], the important point towards resolving the problem in the context of self-directed learning is how to help learners monitor their own navigation process [4]. In this paper, we address the issue of how to help learners navigate in existing web-based learning resources [4]. Our approach to this issue is to provide them with a navigation path planning environment apart from hyperspace. The key point of this idea is to allow learners to preview a sequence of web pages as navigation path plan. The previewing enables them to plan the navigation path in a self-directed way before navigating the hyperspace. It is accordingly expected to call their attention to making a navigation path.

The important point of this approach is how to provide learners with a proper previewing of the web pages on the navigation path plan. In general, web page often has several topics. Which topic should be principally previewed depends on the context of planning the navigation path. The main issue addressed here is accordingly how to adapt the previewing to the context of planning a navigation path, which we call adaptive previewing of navigation path [3]. The adaptive previewing identifies the focal topic that learners intend to focus on in the web page, and generates the page preview with hierarchical structure of the HTML document. Such adaptive previewing enables learners to plan a navigation path in a proper way.

2. Navigation Path Planning
2.1 Difficulty in Navigation
On the Web, learners can navigate web pages in a self-directed way by following links among the pages to learn domain concepts/knowledge embedded in the navigated pages. However, learners often fail in making the navigation path and reach an impasse. There are two main causes as follows [5].

- The learners cannot foresee what they should navigate next from the current page for achieving their learning goal due to the complexity of hyperspace.
- The learners need to concurrently make diverse cognitive efforts not only at planning a navigation path but also at setting up global/local learning goals, comprehending the contents navigated, and so on.

2.2 Framework
The important points towards the problem are how to give learners a transparent overview of hyperspace and how to call their attention to planning a navigation path [4]. The main point of this idea is to divide learning process into planning and navigation phases. In the planning phase, learners decide a sequence of pages to navigate. In the navigation phase, on the other hand, they are expected to navigate hyperspace according to the path planned. These phases are repeated during learning in hyperspace. Our approach is accordingly to provide planning and navigation environments for each phase and to support cognitive efforts on each phase.

Following the idea of path previewing, we have developed Path Planning Assistant.
Hyperspace Map. Path Previewer makes a sequence of previewed pages with a link list which includes anchors of the links that the current page contains. The learners can select any one from the list to have a preview of the page, and displays it as navigation path preview. These facilities help them plan which pages to navigate without navigating real web pages. Navigation Controller on the other hand, enables learners to navigate along their navigation path plan in a simply way.

3. Adaptive Previewing

3.1 Problem Addressed

Although web page generally includes several topics, every topic does not always need to be previewed when learners plan a navigation path. Which topic should be principally previewed depends on the topic learners intend to focus on in Path Previewer. We call it focal topic. The problem addressed in the adaptive previewing of path planning is to generate a proper page preview in consideration of the focal topic that is regarded as the contextual information of planning the navigation path [3].

3.2 Adaptive Preview Generation

In the adaptive previewing, the preview generation consists of the following two steps that are executed in Path Previewer:

1. To identify the focal topic of learners, and
2. To identify the focal section, that is information to be previewed according to the focal topic.

Path Previewer first identifies the focal topic with keywords included in the anchor that learners select from the link list of the current page for previewing the next page.

Table 1 shows the results of this study. Correspondence means that the section, which is identified in both, agreed completely. Partial Match means that the section that the subject identified includes the section that the adaptive previewing identified. Difference also means that the section disagreed. These results show that the system-identified sections agreed with the subject-identified sections approximately about 88% of their total composition.

In the future, we need a more detailed evaluation of the adaptive navigation path previewing with the system. We would also like to improve it according to the results.

4. Conclusion

This paper has described a navigation path planning aid for self-directed learning in hyperspace provided by web-based learning resources. The key idea is to provide learners with adaptive preview of navigation path plan to help them plan their navigation process, which is an important process of the self-directed learning. The adaptive previewing enables them to plan the navigation path in a proper way before navigating hyperspace.

Although these results were limited to two resources used in this study, we believe that the adaptive previewing enables learners to provide a better preview in accordance with their planning context.

Table 2. Results of Case Study

<table>
<thead>
<tr>
<th></th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correspondence</td>
<td>32 (53%)</td>
</tr>
<tr>
<td>Partial Match</td>
<td>21 (35%)</td>
</tr>
<tr>
<td>Difference</td>
<td>7 (12%)</td>
</tr>
</tbody>
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References