TRUC: AN E-LEARNING TOOL FOR RISK AND UNCERTAINTY CONCEPTS

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ABSTRACT
Web enabled electronic learning tools (eLearning tools) gained much attention, lately. Key questions are how to endow an eLearning tool with the right type and level of interactivity and how to personalise the learning material offered. Personalisation should tailor massive learning material to the capacity and present needs of the student, while companies must be able to match the learning material to their business, projects and cases. This paper discusses the development of the TRUC eLearning tool for basic statistics, risk and uncertainty concepts. This web-based tool treats these concepts at various levels of mathematical skills. Apart from a personalised version, the tool can also be used as a traditional (electronic) textbook or a reference text. A central Glossary safeguards consistent use of terminology.

INTRODUCTION
From a company point of view, bringing trainees together at (a series of) fixed moments in time in a central classroom interrupts business and comes with considerable costs. At the same time, companies want to be able to match learning material to their businesses, projects and cases. This paper discusses the development of the TRUC eLearning tool for risk and uncertainty concepts. This web-based tool treats these concepts at various levels of mathematical skills. Apart from a personalised version, the tool can also be used as a traditional (electronic) textbook or a reference text. A central Glossary safeguards consistent use of terminology.

THE TRUC E-LEARNING TOOL
TRUC (Training Risk and Uncertainty Concepts) is a web-based eLearning tool that seeks to train individuals and groups of students in the proper use of risk and uncertainty concepts. Central to its approach are the notions of levels, the organisation of the material and interactivity.

Levels
The way and the depth at which these concepts are studied may vary considerably across a company. The more expert, the more mathematically oriented, generally. Therefore in TRUC three mathematical skill levels are distinguished:
1. managerial - where principal concepts are commonly discussed, avoiding the mathematics altogether or using it only at the level of reasoning and logic;
2. introductory - for those trainees lacking a firm mathematical background;
3. expert - where mathematics and mathematical statistics constitute the starting point for further treatment of the risk and uncertainty concepts.

It is important that the level of mathematics used is coherent throughout the presentation of the material. This includes the presented examples, exercises and glossary texts.

Organisation of the Material
Furthermore, TRUC has been organised such, that it can be used by three different types of users, irrespective of their math skills level:

Previous Work
As of yet, introduction textbooks to eLearning concepts are scarce, particularly for the type of applications discussed here (Christ et.al. 2000). In contrast, literature on statistics (e.g. Cramér 1999) and mathematical statistics (e.g. Patel and Read 1996) is massive. Introductory texts to risk and decision analysis (Newendorp 1975; Megill 1984) and recent introductions to game theory (Curiel 1997; Rosenmüller 2000; Rasmusen 2001) are less abundantly available as well as an introduction to portfolio management (Elton and Gruber 1984).

Objectives
The objective of this paper is to merit the gains and benefits of eLearning tools, exemplified by TRUC and to report on the chosen implementation details in order to provide an answer to the following two key questions:
1. How to endow an eLearning tool with the right type and level of interactivity and fully exploit the capabilities of modern electronic environments?
2. How to personalise the offered learning material, both from a trainee point of view and from a company point of view?
1. classic - like a student going through a textbook, chapter by chapter, imposing the restriction that the TRUC content stays basically organised as a classical textbook;

2. selecting - the user that wants to go through pre-selected material and that material only, with the associated examples and exercises;

3. referring - a user that wants to look up only one particular topic, case, graph, term, definition, or the like, on an occasional basis.

The corresponding design issues are:

1. clever (alternate) navigation that ensures organisational integrety;

2. personalisation framework resulting in a workbook;

3. context aware glossary.

Interactivity

A third basic incentive is to combine the static content with a high level of interactivity and room for experiments. This is mainly accomplished by the use of Java applets and games. These are accessible from almost any location within the material. Wherever to be encouraged, the text provides a hyperlink, and passes material. Wherever to be encouraged, the text provides a hyperlink, and passes material. This is mainly accomplished by the use of Java applets and games.

Interactivity

The restriction that the TRUC content stays organised as a classical textbook implies that the learning material is organised in an educationally proper order with logical transitions and guidance between the individual topics. To accomplish this, the learning text has been organised throughout in a strict hierarchy of modules, topics, sub-topics, and learning items. A module is a self-contained, independent amount of material. Examples: uncertainty estimation, risk analysis or portfolio management. Most of the modules are application- or problem-oriented, while basic statistics is the underpinning, preparatory and fundamental material to other modules required for the implementation of the more math-based levels. A topic is a major entity of learning material within the context of a module. A topic such as analysis-of-variance may have a different meaning within the Risk Analysis module and the Data Acquisition Module. A sub-topic is a major part of the topic and generally also bound by the context of the topic it belongs to. A learning item is the smallest entity of learning material. The standard normal distribution is an example of a learning item.

To comply with the different functions the learning material may have, it is important to identify the possible navigation schemes. These are:

1. the (although trivial) Table of Content scheme, accesible throughout the tool;

2. the Look-Up scheme that navigates from term to definition;

3. the Context scheme, showing the topic and module in which the term is explained;

4. the associative See Also scheme, that shows related terms;

5. the Verification scheme, navigating to examples or exercises;

6. the Routine scheme, navigating to experiments and games.

All of the above mentioned schemes have been implemented in TRUC.

THE GLOSSARY

A central Glossary enforces a coherent use of terminology across all modules. The Glossary, an HTML implementation of a database, needs to support the levels and the navigation schemes, and is divided in a term, a module, a topic and a see also field. The term field is an implementation of the Look-Up scheme, the module and topic fields support the implementation of the Context scheme and the see also field is an implementation of the See Also scheme.

Following the term hyperlink pops up a separate window: the second layer in the glossary. It contains the explanation of the term at the various levels by use of plain English up to a formal definition using mathematics. The Look-Up and See Also schemes are also supported at this level. This layer of the Glossary contains GIF- and JPEG-images to show graphs and diagrams. Furthermore, IBM's TechExplorer plug-in has been used to allow the embedding of LaTeX mathematical notations within the HTML-code.

JAVA APPLETS

A Java applet is in fact a small self-contained program with a user interface in a browser window. TRUC uses applets to create context dependent experimental environments for the student to actively experiment with the provided example and exercise material. Emphasis is on experimenting, rather than on general purpose or accuracy. The applet in figure 1 for instance is intended to provide an environment for experimenting with the normal distribution. It has sliders, arrow buttons and input fields to transform the normal distribution by updating its parameters.

![Applet launched with Context Sensitive Input Parameters to experiment with the Normal Distribution](image-url)
WORKBOOK

The Workbook is the key notion to personalisation and must take away the overwhelming effect of massive amounts of material, examples, exercises, etc. The idea is that the Workbook itself becomes the personalised TRUC. Once personal needs and the appropriate level have been identified, the entire content of TRUC is being filtered accordingly and the filtered material, plus accompanying examples, randomised exercises and a progress meter is inserted into the Workbook for that student. The Workbook is in fact a new set of HTML-files, filtered off from the master set. This way, students will never see more than they intend to study.

ALTERNATE NAVIGATION REVISITED

Now that the details of the elements such as the Glossary have been discussed, the implementation details of the navigation schemes can be presented (see table 1) Note, that on inserting company personalised material, it is important to conserve these schemes. If the need arises, new navigation schemes may be added.

Table 1: Implementation of the Alternate Navigation Schemes

<table>
<thead>
<tr>
<th>Scheme</th>
<th>From where</th>
<th>To where</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table of Content</td>
<td>top of the module and topic HTML-file</td>
<td>topics, sub-topics</td>
</tr>
<tr>
<td>Look-Up</td>
<td>embedded in text, figure captions, glossary, exercises and examples</td>
<td>terms, aliases</td>
</tr>
<tr>
<td>Context</td>
<td>glossary, HTML text</td>
<td>module, topic, sub-topic</td>
</tr>
<tr>
<td>See Also</td>
<td>glossary</td>
<td>term, aliases</td>
</tr>
<tr>
<td>Verification</td>
<td>HTML text, exercise</td>
<td>exercises, examples</td>
</tr>
<tr>
<td>Routine</td>
<td>HTML text, exercise</td>
<td>applets, games</td>
</tr>
</tbody>
</table>

WEB HOSTING

The hosting of the eLearning tool is the final step. One strategy is to install the eLearning tool on the Intranet. In the case of anonymous students, accessing a public URL works just fine and whenever desirable. Workbooks can be downloaded and accessed locally. Sometimes, an eLearning tool requires restricted access, for instance to assure proper licensing and fees. There are various tools to accomplish just this. Adding local files with userid/password combinations suffices to implement the access restriction no matter the location on the Internet the tool is accessed from. Logging of the access is more or less standard on many sites.

CONCLUSION AND FURTHER RESEARCH

Electronic learning environments, commonly denoted by the term eLearning tools, can successfully satisfy the need for personal, remote access, on-line learning tools. Students can be presented just those learning items that are of interest, companies can bring up only those cases that are relevant for their business. Combinations with other developments, such as ERP and CRM are possible and likely. Companies can also use eLearning tools to select competent trainees. Interactivity, relevant examples and self-assessment are the important keywords. The design and approach discussed in this paper have shown that the needs for different types of users at various levels of math skills can be combined using various navigation schemes in combination. A high level of interactivity by playing games and realistic scenarios can provide routine and productivity in addition to basic knowledge and group learning facilities. Developing eLearning tools is expensive, but training cost savings can be considerable. Crisp figures do not yet exist and depend highly on the matter and situation.

Further research targets in the first place at improvement and expansion of the existing modules. Feedback regarding examples and exercises is important, but also regarding additional topics. We also aim at further personalisation of the material offered and increased effectiveness and efficiency of the course material. The final word with respect to the workbook concept has not yet been spoken. It is most likely that artificial intelligence is required in order to leap further in this regard.

REFERENCES


