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Three-Level Teaching Material and Its Implementation in Teaching Situation

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Three-Level Teaching Material
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Its Implementation in Teaching Situation

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Abstract

Lectures need three kinds of supporting material: lecture notes given to learners, presentation material to be shown in the lectures, and lecturers own guidance material to direct her during the lecture. Current presentation systems do not support easy preparation and maintenance of these three interwoven material sources. In this paper, we present the idea of three-level teaching material and describe a computer-based system (SHOW) that can be used to produce the different forms from a single source and to show the presentation version in a lecturing situation. Other novel features of the presentation part are abolition of the slide paradigm and discrimination of textual structures with colors during presentation.

Key words: Computer assisted instruction, CAI, computer-aided lecturing

CR categories: K.3.1, I.7.2

Contents

1. Introduction

Current trends in teaching stress the role of the learner in actively acquiring new information by herself (Greeno, 1991; Lave and Wenger, 1991; Vosniadou, 1994). The teacher is seen as a guide whose role is to provide the learner with appropriate environment and to show where sources of information can be found (Hannafin & al., 1994; Maxwell, 1995). Consequently, information technology is used in the learning situation by learners as a direct source of information (i.e., CAI applications) or as a media through which learners can find information provided by the teacher (i.e., distant learning) or by others (e.g, WWW exploration).

Much less has been said about the use of information technology by the teacher in a teaching situation. This neglect may be due to the cost of teaching as opposed to the cost of learning: if learners can learn by themselves then costs can be cut down. Another reason is, of course, the rapid development of information networks (Internet, especially) which cuts down the costs of giving special courses to people that are scattered around a physically large area.

There are, however, situations where lectures of the traditional form are needed. When the issue to be learned has an exact nature, e.g. in medicine or engineering, it is not possible to see the learner as an explorer who will create her own view of the area. When the number of learners is large, it is also impractical to provide them all with their own PCs. Finally, deep understanding as well as many philosophical and ethical issues are easier to acquire with a lecture given by a living teacher.

Thus, traditional lectures are needed in many cases. Current technology provides three main means for the lecturer to visually present material to learners:

* live creation, e.g. chalk and blackboard,

* ready-made unchangeable presentations, e.g. slides or video, and

* ready-made changeable presentations, e.g. projection of computer screens that can be easily edited both during the presentation and from one presentation to another

Live creation is slow and can be used in rare occasions, mostly together with other means. Unchangeable presentations work usually fine but their problem is maintenance: next time the lectures are given there is often a need to make changes in the material which means that large parts must be processed again leading to tedious work. Therefore, changeable presentations are needed, and they can only be produced by using information technology.

In this paper, we shall first consider the requirements a lecturing situation imposes on the presentation techniques. Then we will introduce a lecturing system that fills these requirements. Finally, we will shortly discuss our experiences in using the system.

2. Three Levels of Teaching Materials

Traditional lectures have an "identity crisis": current technology gives many easy ways to deliver the same information much faster and independently of lecture hours. For example, lecture notes can be read in a much shorter time that it takes to attend the lectures. But the information in lecture notes rarely covers all details and just reading the notes does not give the same understanding of the subject as attending the lectures. In univer-

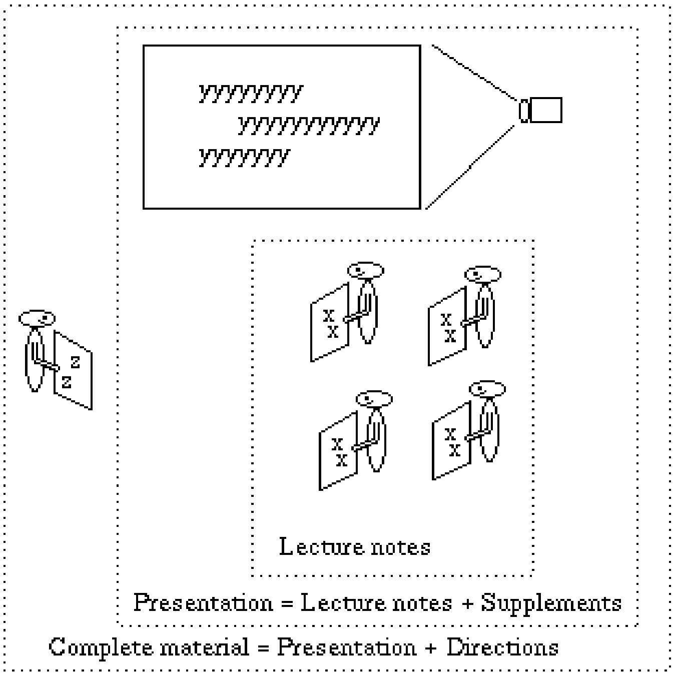

Figure 1: Three-level nature of teaching materials.

sities, where attendance is voluntary, students must therefore be couraged to attend lectures which can be done by showing them clearly that lectures contain issues that are not covered by the notes. As a consequence, there must be at least two levels of teaching materials: lecture notes given to the learners and supplementary material presented in the lectures only.

But two levels of teaching materials do not suffice. The lecturer needs personal directions that are not intended to be shown to the audience. These directions include hints for the presentation, schedule proposals etc. The complete material should, therefore, have three levels with different visibilities: material given to the learners, material shown during presentation, and complete material available to the teacher. Figure 1 gives a schematic description of the levels. In some cases lecture notes cover material that is not intended to be presented in the lectures but the inclusion of such material in the presentation material is not a problem if it can be skipped in a fast and easy way during lectures.

To make the maintenance of teaching materials easy all the three levels should be included in a single source. As the levels form a hierarchy this should not be a problem but, surprisingly, current tools for preparing teaching materials do not support this scheme. For example, Microsoft PowerPoint recognizes two levels only. PowerPoint slides can be printed in basically two forms: either the materials intended for the teacher only are included ("speaker's notes") or not ("handouts"). The only means to show supplementary materials during the presentation without including them in the handouts, is to use hidden slides, but there is no way to use supplementary materials within a slide.

Another solution would be to use word processing programs. They can be used for presentation purposes, though they are seldom used that way. Word processing programs have no fancy slide change enhancements, but they are not tied to the slide paradigm either. The whole idea of slides does not come from the subject to be taught but from the tradition of preparing separate transparencies for overhead projectors. Now that transparencies are no longer needed, there is no need for the slide paradigm but still commercial presentation systems impose it. With word processing programs text and pictures can be scrolled freely giving more freedom than the slide paradigm. Moreover, if the lecture room is equipped with a high resolution projector, then this extra resolution can be used to show more text at a time. High resolution may, however, mean smaller text that is hard to read. Therefore, a fast mechanism to change the font size during presentation is needed.

But most word processing programs have problems with three-level materials. For example, the notion of hidden text provided by many word processing programs can be used to provide two levels but it does not support the third level.

3. The SHOW System

We have implemented a simple three-level system (Sandwich Hierarchy for OmnifariousWare, SHOW) for the presentation of textual material. The system runs on a PC whose screen is projected for the audience during lectures. The system supports plain text files but it can be used together with other tools (e.g, SGML-Tools (Welsh, 1996)) to produce better-looking lecture notes together with plain text presentation version.

All the three levels of the presentation material are in a single text file. The system consists of two programs: one to present the material at the presentation level and another to produce the different versions. Figure 2 gives an example of the outlook of the original text. Presentation level material is marked in the original text by enclosing it with << and >> at the end. Directions intended for the teacher only, start with a < at the end of a line and end with >>.

Figure 3 shows the learners' version which contains lecture notes consisting of the base text only. (The example text is taken from the GEE User's Manual (Sajaniemi and Niiranen, 1996)). The same text is in Figure 4 as shown by the presentation program. Supplementary text is now shown in a style different from that of the lecture notes. Thus the audience can easily recognize which parts are new material. Directions intended for the teacher only are not visible (as otherwise the whole audience could see them) but they are marked with a special mark >< to remind the teacher that there is some extra information in the teacher's own print-out.

The system allows the teacher to discriminate parts of the text with by applying different colors to text selections during the presentation as shown in Figure 4. Thus it is possible to direct learners' attention to different parts of the text by gradually adding colors to important words, phrases, program statements, variables etc. discriminations are preserved even if the text is scrolled or edited and they disappear only if requested by the teacher.

By default, text cannot be edited to prevent accidental operations during presentation. Editing can be easily enabled and disabled by the Edit/Enabled menu selection if, e.g., spelling errors have to be corrected.

Text can be scrolled with the keyboard and the scrollbar in usual ways. Moreover, text positions can be marked with symbolic one-letter names providing a fast mechanism to jump forth and back in the text. It is also possible to search text forwards and backwards, though there hardly is any use for this feature during lectures.

Fonts and colors used for texts of different levels as well as the background color can be freely changed during presentation. There are some ready-made font and coloring schemes available through menu selections, and the teacher can select any fonts and col-

```
After a while GEE Analyser shows you the task summary of the task.
The final graphical representation of the task can be obtained by
clicking the <Result image> button. GEE shows the final representation
(created originally by the subject) and the caption of the <Result
image> button changes to <Task summary>. Click this button to get
back to task summary.
<<
A task summary could look like the following:
#Protocolfile: c:\gee\test\proto.prt
Taskfile: c:\gee\test\task3_2.tsk
Subject: Sub13
Task termination: normal
Task time: 32.73
Task termination keyboard input: 'd'
Used images:
mhepo.ico              2
vsolttu.ico            1
Number of used images:  3>>           <

-------------------------------------------------------------------
REMEMBER TO CLARIFY THE FOLLOWING:
* The number after the image name (e.g., mhepo.ico 1) indicates the
total number of copies of an image that have been used in the
graphical presentation.
* Moving an image does not increase the number of image copies.
* If an image was deleted the number of image copies will be
decreased.
-------------------------------------------------------------------
>>

Both the task summary and the final graphical representation can be
printed on paper. Click the <Print> button to obtain Windows' print
dialog window. Note: the data to be sent to your printer depends on
what kind of results you were viewing at the time of clicking the
<Print> button. If you were viewing at the task summary, the task
summary will be printed. But if you were viewing the final graphical
representation, the representation will be printed.
```

Figure 2: Text with three levels.

```
After a while GEE Analyser shows you the task summary of the task.
The final graphical representation of the task can be obtained by
clicking the <Result image> button. GEE shows the final representation
(created originally by the subject) and the caption of the <Result
image> button changes to <Task summary>. Click this button to get
back to task summary.

Both the task summary and the final graphical representation can be
printed on paper. Click the <Print> button to obtain Windows' print
dialog window. Note: the data to be sent to your printer depends on
what kind of results you were viewing at the time of clicking the
<Print> button. If you were viewing at the task summary, the task
summary will be printed. But if you were viewing the final graphical
representation, the representation will be printed.
```

Figure 3: Lecture notes version of the text of Figure 2.

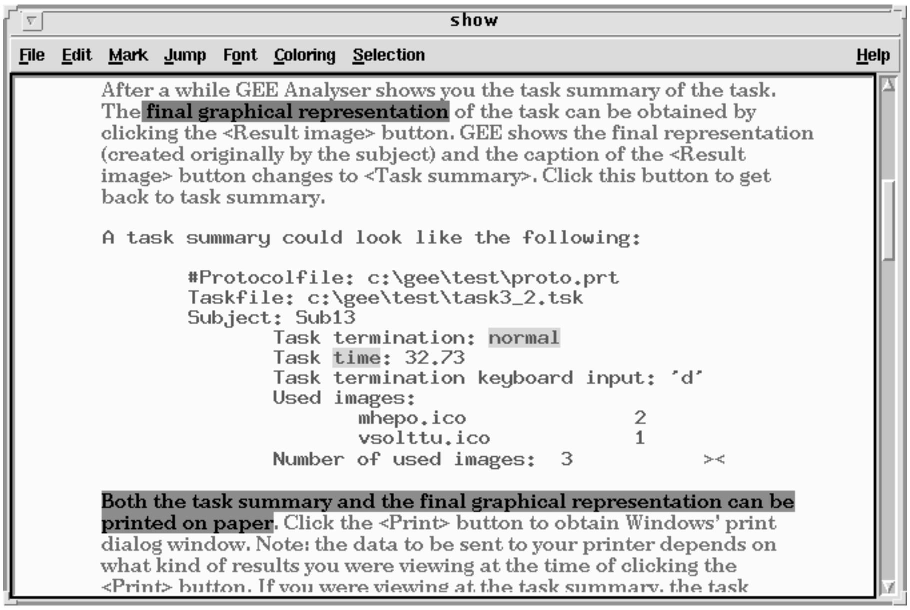

Figure 4: Outlook of a presentation.

ors that the underlying window system supports. Figure 5 shows the windows for font and color selection, and the Edit-menu teared off the menu bar. The selected font, as well as color, can be applied to the parts belonging to the learners' version ("Text") or to the supplementary material ("Enhanced"). Color can be applied to the background, also. The selected color is seen in the color window, and fonts can be browsed with an external font browser (xfontsel).

The current font and coloring scheme can be saved in a file for later use. Even the fonts and colors bound to menu selections (including the colors used for discriminations) are read from a file, or they are given by the system if there is no such file. Thus one can create different schemes for different presentation equipment and lighting conditions. For example, we selected the original discrimination colors so that they looked nice on a normal PC

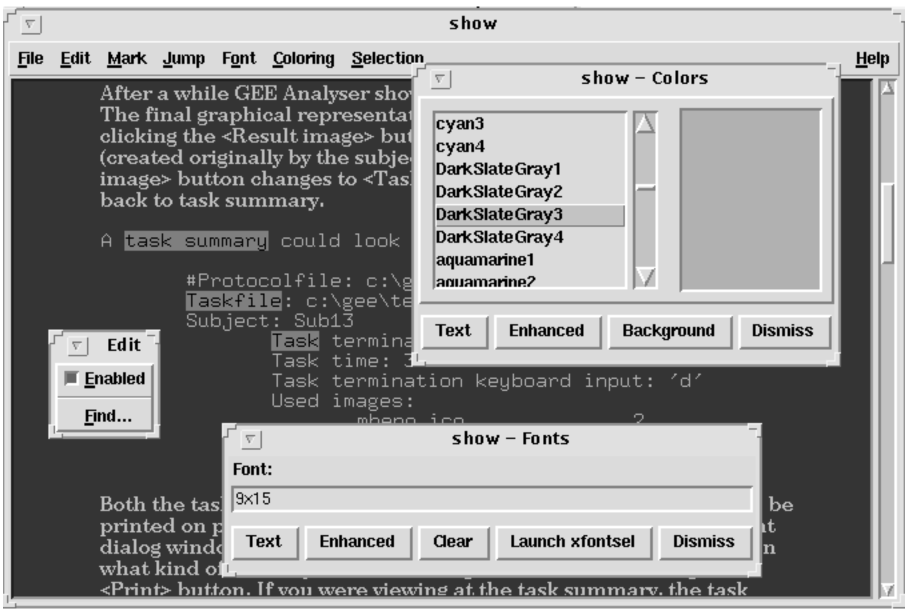

Figure 5: Setting fonts and colors.

screen, but the text was hard to read when projected. As a consequence, the current setting used for projection has much lighter background colors.

The SHOW system is implemented using C for the program that produces the different versions from the base text and Tcl/Tk (Ousterhout, 1995) for the presentation program. Tcl/Tk provides key accelerators for menus, and tear-off menus making menu selections fast. The font and coloring selection windows as well as file selection dialog boxes do not to disappear unless required by the teacher. Thus it is possible to make rapid changes easily during presentation. The system runs on UNIX and Linux machines but with small modifications it can be easily ported to other platforms that support Tcl/Tk, e.g., Microsoft Windows.

4. Experiences

We have used the SHOW system on an object-oriented programming course with mainly positive experiences. The system has been easy to use, it has been practical for the presentation of both normal text and programs, and the method has worked reliably.

The use of a computer has the additional advantage that other programs can be run and shown to the learners as well. In our course, we have run example programs in one window and shown their code with SHOW in another window. The students have thus had the opportunity to see the effects of different program structures in a concrete way.

But the use of a computer brings some problems, also. The physical environment may not be ergonomic, e.g., in our case the location of the mouse was impractical causing arm ache. The brilliancy of our projection system was low and we had to keep the room dim. Students had some problems in writing down their notes but on the other hand they were excited of the exceptional lighting conditions.

After 6 weeks of lectures we sent a questionnaire by e-mail to 71 students that had attended at least one lecture, and we got 35 replies. Students gave a positive feedback on the use of the SHOW system, e.g.:

* the idea of scrollable text (as opposed to slides) is positive
* the use of different discrimination colors (e.g., to show how different parts of a program relate to each other) is positive
* the avoidance of hard-to-read handwriting is positive
* demonstrations of running programs is positive
* fonts and colors must be selected carefully so that they can be discriminated and that text can be easily read
* focusing problems (of projection equipment) are negative

We asked the students to rate the following four presentation techniques (given in alphabetical order): blackboard, computer, ready-made slides, and writing on slides. Table 1 gives a summary of the ratings (with totals differing from the number of replies as some students gave the same rating to many presentation techniques). The results show clearly that the use of a computer was considered to be the best technique.

Table 1: Ratings of various presentation techniques

	1st	2nd	3rd	4th
Blackboard	6	6	9	12
Computer	20	7	5	1
Ready-made slides	7	9	6	11
Writing on slides	6	7	14	6

For those students (n=17) who had attended the same lecturer’s blackboard presentation in a different course during the previous term, we asked some questions about that course, too. The difference in the easiness of following the subject in these courses was minimal, 4.21 (on scale 1-5 where 5 is the best) for the computer course and 4.16 for the blackboard course, but the easiness in reading the texts during lectures was larger, 4.21 for the computer and 3.77 for the blackboard. A possible interpretation of these results is that the effectiveness of teaching depends more on the teacher than on the technological environment but that suitable technology makes learning more pleasant.

The amount of features of the SHOW system seems to be quite sufficient. A lecturing situation requires much of the teacher. She must concentrate on the subject itself, on the way the subject is described to the learners, and on the tools used in this presentation. As a consequence, the amount of attention she can direct to the tools is small. To prevent mistakes, the tools should be as familiar to the teacher as possible. This includes not only the presentation tool (e.g., SHOW) but the whole environment, like the operating system and the window manager. Especially, features that are used only rarely tend to be forgotten during lectures. As the SHOW system is hardly ever used outside lectures, there is no sense in incorporating a huge amount of features in it. If new features will be added then some features are likely not to be used in real situations.

If the projected text consists of normal paragraphs with complete sentences, it is not easy to articulate the same information with free speech; neither is it easy for learners to follow the text and the speech simultaneously. We found that short bulleted style with incomplete sentences was more comfortable. As lecture notes are produced from the same material they will be presented in the same way. Thus, the use of three-level material leads in practice to that kind of lecture notes.

To make the font system simple and easily understandable, the current version of the system does not support multiple fonts within any single level. Sometimes there was a need for a fixed-width font for some parts of the text while other parts did look better with a proportional font. Such a situation could, however, be easily handled by changing the font scheme of the whole text. Changes could be made fast by having the other font (usually the proportional one) in the default font scheme (so that the font could be loaded by pressing Alt+f followed by d) and the other font in the font menu (so that it could be loaded with two keystrokes also).

5. Conclusions

We have presented why three-level teaching material is needed in a lecturing situation. As current presentation tools support two levels only, we have developed a new tool, the SHOW system, that makes the use of three-level material possible. In addition to three-level support the presentation part has some novel features not included in other presen-

Table 2: Comparison of various presentation tools

	SHOW	Presentation systems	Word processing	Web browsers
Three-level support	+	-	-	-
Color discrimination	+	-	-	-
Free scrolling	+	-	+	+
Fast jumps	+	-	+	+
Position marking	+	-	(+)	-
Searching	+	-	+	+
Font configuration during presentation	+	-	(+)	+
Color configuration during presentation	+	-	-	-
Hypertext	-	-	-	+
Graphics	-	+	+	+
Mathematical formulas	-	(+)	(+)	(+)

\+ Feature included
\- Feature not included

tation tools. Table 2 gives a summary of the properties of SHOW, typical presentation systems (e.g., Microsoft PowerPoint), word processing programs, and current Web browsers (e.g., Netscape). The properties have been selected on the basis of requirements that evolve from a lecturing situation.

The SHOW system supports plain text files only. It is, however, easy to use the system with other text formatting tools. For example, the main text can be written in a format understood by the SGML-Tools system (Welsh, 1996). Now the student's and teacher's versions can be processed by sgml2latex for a better outlook, and the presentation version can be made by sgml2txt to produce a nice-looking plain text version.

The notion of three levels is not restricted to text only. Figures could be included even in learner's paper copies, and sound as well as video sequences could be used provided the learner's versions were allowed to include multimedia features. Such extensions would impose new requirements not only on the SHOW system but on the teacher preparing the material, also. At the moment, the SHOW system supports text only. Figures must be shown using other programs which is not a problem per se; the only problem is that these external programs do not support the idea of three levels.

Acknowledgments

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