

Cueing for transfer in multimedia programmes: process worksheets vs. worked-out examples

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Abstract

We investigate the effects of cueing, in a multimedia programme for the individualized training of the 'whole task' to prepare a plea, on the learning outcomes of 43 sophomore law students. The cueing formats of worked-out examples (WOEs), process worksheets (PWs), and both WOE and PW are compared to a no-cueing control condition. Our hypotheses that WOE enhance near transfer, by stimulating imitation processes to similar tasks, and that PW foster far transfer, by stimulating mindful abstraction processes to different tasks were partly confirmed by learning outcomes on the training task and two transfer tasks.

Keywords

cueing, transfer, worked-out examples, process worksheets, schema-based learning

Introduction

Mastering complex problem-solving competences is the ultimate goal of higher education. *Competence* can be defined as the whole of knowledge and skills that people have at their disposal and which they can efficiently and effectively use to reach certain goals in authentic situations (Kirschner *et al.* 1997). Although the importance of solving authentic problems is recognized in professional practice, it is not sufficiently acknowledged or articulated in the Instructional Design literature. This was recognized by Hummel and Nadolski (2002), who presented guidelines for effective cueing in competence-based training. This study examines the effects of cueing formats in a multimedia programme from the domain of law training the competence to prepare a plea.

The problem solver's understanding of the problem, the initial problem state, intermediate states and goal state, along with the operators for moving from one to

the other, is known as the *problem schema* (Wood 1983). *Cueing* is defined for this study as a possible instructional technique to facilitate the interpretation and construction of problem schema to enable *transfer* in solving similar problems (near transfer) and not similar but related problems (far transfer). This near/far distinction in transfer is closely related to the issue of context-dependent versus context-independent strategies in programming (Perkins & Salomon 1989). We must note that this concept of similarity is relative to its context: within the domain of law, to transfer a pleading competence from civil to criminal law will be considered as far and not similar; within the domain of oral communication as near and similar. Instructional guidelines and empirical data on effective cueing formats in competence-based learning are sparse, and techniques to facilitate schema-based learning have primarily been studied in contrived learning situations with relatively short, well-structured and self-contained tasks (Mory 1996). Balzer *et al.* (1989) show that the so-called task-valid cognitive feedback improves *learning* to monitor the adequacy of available schemata, and to construct more efficient schemata. Other researchers (e.g. Whitehall & MacDonald 1993; Narciss 1999) show positive effects of this cueing on recall and interpretation of available schemata; a

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larger amount of task-valid information leads to more effective *performance* on related tasks.

Problem schema

Problem-solving expertise heavily depends on the presence of knowledge structures that wrap up numerous information items as single items organized in a way to be widely used, often referred to as schemata (e.g. Chi *et al.* 1981). Where novices have to rely on superficial similarities between concrete problems (e.g. Sweller 1988), experts have learned more structural problem schema that categorize and solve various problems (Chi *et al.* 1981). According to schema-based learning, learners actively recall and interpret old schemata and construct new schemata in light of new information or cues. Schemata enable us to recognize a problem as a member of a class (e.g. a civil law case) and find a procedure appropriate for *all* problems of that class. Using a problem schema or finding analogies in new problem situations (e.g. a criminal law case) is the key to *transfer* and the ability to apply training problems to everyday and professional problems (e.g. for lawyers to hold effective pleas for *various* law cases, and not just for the ones they were trained for).

Task-valid cueing

Pellone (1991) explains the difference between feedback, reinforcement and cueing from behavioural learning theory. He argues that students should always be told whether they have given the right answer (feedback), be praised for giving a correct answer (positive reinforcement), or prompted when they need more information (cueing). Cueing is often equated with domain-independent, generic or reflective prompting, like in Comprehension Gauging Questions (Chi *et al.* 2001) or the Leittext-method (Koch & Selka 1991; Teurlings 1995). Learners are then provided with domain-independent judgement prompts or leading questions (Land 2000), like: 'Do you understand the assignment?', 'Are you sticking to your initial working plan?' or 'Didn't you overlook something?'. In this study, task-valid cueing is operationalized as *domain-related content prompting or -hinting*, containing information about the attributes of multi-attribute objects of judgements in complex problem-solving tasks in a

specific domain. Schemata represent the relations within and between these objects.

Two formats of task-valid cueing

A 'whole-task' or case-type (Van Merriënboer 1997), like preparing a plea, is made up of specific subtasks or steps that learners will subsequently work, one for each case of that type. Both concrete, more product-oriented cueing and abstract, more process-oriented cueing, are needed for schema-based learning in each step. *Product-oriented* formats pay no attention to the general characteristics of problem-solving process itself, but only involve specific given states, goal states and solutions. Worked-out examples (WOEs) focus learners' attention on *concrete* problem states and associated operators, enabling them to interpret and select existing schemata and *induce* more generalized solutions. *Process-oriented* formats pay attention to the problem-solving process by providing *general* strategies and heuristics, enabling learners to construct or adapt schemata and *deduce* a specific solution. Process worksheets (PWs) contain a layout with keywords or leading questions (Land 2000) reflecting a strategic approach. Ley and Young (2001) suggest for individualized learning to combine evaluation criteria as a quality control checklist (like a PW) during assignment preparation and later provide assignment evaluations (like a WOE) based on the same criteria. The multimedia program *Preparing a plea* (Wöretshofer *et al.* 2000) requires law students to learn and demonstrate the 'whole task' of preparing a plea to be held in court (see Fig. 1 for an impression). We asked participants to learn to prepare the plea while varying the availability of the PW- and WOE-cueing formats.

PWs

In the social and liberal arts domains, it often is difficult to objectively decide on the best solution for a complex problem. What can best be established is a systematic approach to the problem (SAP) in general, with possible steps to reach a solution. We expect PWs to structure learning sequences and identify important concepts for learners *in a variety of situations*, directly relevant for the construction and mindful abstraction of schemata. PWs are expected to be most effective for expert learning outcomes on process-oriented tasks,



Fig. 1 Screen dumps. *Preparing a plea*: an example of a CMP in the domain of Law. The learner is given the role of trainee or junior lawyer in a (virtual) legal firm. He or she must prepare a plea for various cases. A (virtual) mentor introduces the way a plea should be prepared and comments on various activities of the learner during preparation. Clockwise you find the following virtual environments: The trainee's office (where he/she can search a file cabinet, or mailbox, and e-mail reports on tasks to the mentor); the mentor's office (where the trainee may go to ask questions); external experts and colleagues within the law firm that learner can consult; and a video player on which the trainee can observe – both good and bad – examples of pleas by others with the help of a 'plea-checker'.

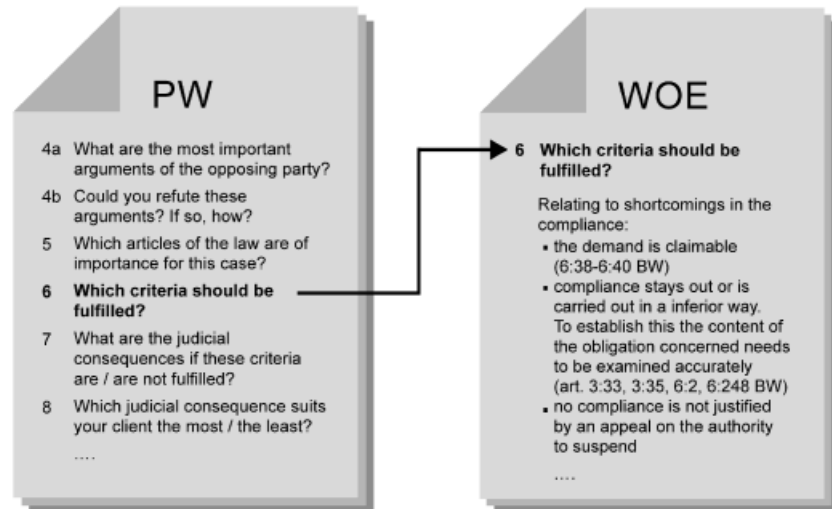
like drawing up a pleading inventory, where the search for relevant legal information is structured by leading questions. Instructional techniques that systematically structure content, such as concept mapping, advance or graphic organizers, previews, and structured overview have increased learning outcomes (e.g. Price & Driscoll 1987; Driscoll 2000). Catrambone (1996) documented the efficacy of two techniques designed to accentuate discrete sub goals: labels and the visual separation of steps. He asserted that labels serve as cues to chunk a set of steps together and encourage a learner to explain why the steps are grouped together. In their review article Atkinson *et al.* (2000) state that an important instructional principle to support problem solving is to *emphasize the conceptual structure by labelling or segmenting* content. In teaching statistical concepts, Quilici and Mayer (1996) concluded that structure-emphasizing techniques are effective because they demonstrate to students that a reliance on surface features does not work. In *Preparing a plea* many task characteristics have to be considered (sub-tasks) within each step of the SAP, some of which are interrelated. For each step learners are offered a PW with leading questions, checkpoints or criteria that guide learners in their search for relevant information. As an example, for studying the file (step 3 of the

SAP) to draw up a pleading inventory some of the questions in the PW can be found in Fig. 2.

WOEs

The notion of learning by example has been a major theme in educational research for at least the past four decades. We expect WOE to support learners in applying useful problem schemata, to categorize problems with *similar* solutions and find solutions to new problems by analogy to the example. The support of WOE within a training task is expected to increase learning outcomes especially for novice learners and on product-oriented tasks, like writing a pleading note or holding the actual plea, because learners can directly imitate and apply superficial characteristics of examples on products they have to deliver (e.g. making a practical joke at the start of the plea). Atkinson *et al.* (2000) have stated that important instructional principles to support problem solving are to *employ surface features to signal deep structure*, and to present examples in close proximity to matched training problems. In this study product-oriented WOE are used and operationalized as possible (expert) solutions for specific problem-solving steps, focusing the learner's attention on problem states and associated operators.

Fig. 2 Excerpts taken from concrete cueing examples. When studying the file of case X (step 3 of the SAP) students draw up a pleading-inventory for case X. Some of the leading questions in the process worksheet (PW) that have to be considered can be found on the left side; part of the expert solution in the worked-out example (WOE) (i.e. possible answer to leading question 6) can be found on the right side, with article numbers referring to Dutch Law.



More process-oriented WOE's can also be studied and may foster far transfer, but this cueing format was left out of scope in this study. In several subject domains evidence has been found that studying WOE yields lower extraneous cognitive load, better schema construction, and higher transfer performance than solving the analogue problems (Sweller *et al.* 1998). In *Preparing a plea*, at the end of each step learners can compare their reports with a WOE and see expert's answers to questions in the PW. As an example, a part (answer to leading question 6) of the pleading inventory (step 3) might look like the WOE in Fig. 2.

Our first hypothesis is that WOE offer best support (a) for interpreting schemata and inducing a general solution in similar situations (near transfer) and (b) for more product-oriented tasks, since WOE's offer concrete product-oriented information that can directly be interpreted. Our second hypothesis is that PW offer best support (a) for constructing schemata and deducing a specific solution in not similar situations (far transfer) and (b) for more process-oriented tasks, since PW offer generic process-oriented information. In the long run we expect PW's to have most fundamental effects on schema-based learning, because expert learners focus on mastering deep process techniques and general requirements before focusing on surface characteristics of products and specific outcomes (e.g. Schunk & Schwartz 1993; Zimmerman & Kitsantas 1997). For example, experts have learned that to start a plea with a practical joke (a specific solution) will *not always* be the appropriate way to 'get attention from the judge' (a general requirement) *in every* law case.

Method

Participants

At the start of this study, 57 students enrolled in the experiment, organized in the context of the regular court practical they had subscribed to. Students were equally and randomly assigned to four cueing conditions, but due to study-planning problems eventually 14 students dropped out. A full data set on the experimental training and transfer tasks could eventually be collected for 43 students (both PW and WOE, $n = 10$; PW only, $n = 12$; WOE only, $n = 9$; and no cueing, $n = 12$). These students received the equivalent of about 180 US\$ for participation in the experiment. All participants were Sophomore Law students (25 female, 18 male; mean age = 24.12 years, $SD = 6.65$) studying at two Dutch universities. Since first year law curricula of Dutch universities are practically identical, the students did not differ with respect to domain knowledge. A prior knowledge questionnaire was used to check for possible differences in pleading experience. Analysis of variance revealed that the overall prior presentation skills on a 18-point scale were low ($M = 2.88$, $SD = 2.72$) and did not differ as a function of cueing condition ($F(3, 39) = 0.33$, $MSe = 7.81$, $p = 0.81$, $\eta_p^2 = 0.03$).

Learning material

An adapted version of the multimedia programme *Preparing a Plea* (Wöretshofer *et al.* 2000) had to be studied as a part of the regular court practical participants were enrolled for. The learning objective of the

programme, with an average study load of about 40 hours, is to acquire the competence to prepare and carry out a plea in court. The programme starts with a non-compulsory task to get acquainted with the programme and the stepwise procedure, after which students receive the nine-step whole-task training. Training consists of one compulsory training task (a civil law case), and two additional non-compulsory training dossiers, before the compulsory transfer task (a criminal law case). The additional non-compulsory training dossiers are available to create a higher variability of practice with the stepwise procedure. Within every step students have maximal freedom of study. During the nine steps (or subtasks) the following constituent skills for holding a plea are trained and combined: (1) ordering the file of the case; (2) getting acquainted with the file; (3) studying the file; (4) analysing the pleading situation; (5) determining the strategy for pleading note, and plea making; (6) writing a pleading note; (7) transforming the pleading note into a plea; (8) practicing the plea; and (9) actually carrying out the plea. At the end of each of the steps (2)–(6), students are required to send in a report to their (virtual) coach. After her approval they are allowed to proceed to the next step. The last steps are carried out outside the programme. For two consecutive steps, the latter always includes cognitive feedback on the former (with expert's WOE of the previous step) as well as a new task instruction (with a PW to support task execution). Each consecutive report is meant to be building on the previous one. So, for instance step 3 of the training task (case Bosmans) results in a pleading inventory report: a selection of legal documentation that might be useful for writing a pleading note. Step 6 results in a written pleading note that (according to Dutch Law) has to be submitted to the judge before the lawyer is allowed to carry out the oral plea in court (Step 9). Support fades as learners gain more expertise, e.g. the training task (case Bosmans) contains all nine steps and each of these steps may contain both a PW and a WOE, depending on the condition, while the transfer task (case Ter Zijde) is the same for each condition and contains only one step and no cueing.

Questionnaire and pleading instruments

At the start of the experiment, participants received a general prior knowledge questionnaire pertaining to their commitment to the field of law, prior presenta-

tion skills, and computer skills. One pleading measurement instrument was developed to measure the quality of the pleading inventory (PI, outcome of step 3). Existing pleading measurement instruments (e.g. Edens *et al.* 2000) can be regarded as too general to be used here. Other instruments measured the learning outcomes of step 6 (PN, pleading note for case Bosmans), and step 9 (PB, the actual training plea for case Bosmans) of the training task, and the transfer plea for case Ter Zijde (PTZ). These three instruments had been used and validated in a previous experiment (Nadolski *et al.* in press). All four instruments were scored by two raters on an average of eighty items, pertaining to both legal content and presentation. The scores were normalized on 100-point scales. Interrater reliability and consistency of these 100-point scales were assessed using inter class correlations (ICC) and Cronbach's α . The ICC (3, k) two-way mixed model (Shrout & Fleiss 1979) for the PI, PN, PB, and PTZ instruments revealed significant AMRs (average measure reliability) of, respectively, 0.85, 0.75, 0.77, and 0.64, with ICC > 0.70 generally considered to be acceptable (Yaffee 1998). Cronbach's Alpha's for internal consistency of these instruments were 0.92, 0.83, 0.80, and 0.73, respectively.

Subjective measures on motivation, mental effort, and time-on-task were automatically collected by the programme after completing each step of the training task. Mental effort had to be scored on an adapted version of the nine-point scale developed by Paas (1992) to measure the perceived amount of invested mental effort of each step in the training task. The extra time-on-task spent outside the programme, together with relevant scores on the questionnaire, was taken to assess motivation (on a 12-point scale). Finally, as all conditions were computer-delivered, all participants' actions and study times were logged.

Design and procedure

Corresponding to a 2×2 design (with both PW and WOE being either present or absent) four versions of the practical were developed that only differed for the within-step cueing provided for the training task (case Bosmans). In version 1 (both PW and WOE), participants received a PW with the task instruction at the start of each step and an expert WOE at the end of each step after submitting their own report. In version

2 (PW only), participants received a PW with each task instruction. In version 3 (WOE only), participants received an expert WOE afterwards. In version 4 (No Cueing) participants received rather global task instructions without further cueing. Besides this, all versions presented identical support tools, like a 'plea checker' to analyse pleas, discussions of ethical issues in pleading, numerous files and documents, and non-compulsory training dossiers.

Before the start of the experiment the participants were informed, both in a plenary session and by a written instruction and programme manual, about the study load (about 40 h) and necessary prior knowledge and ICT skills. Participants were randomly assigned to conditions and were required to work individually. All learning materials, including the written instruction and manual, were sent at the participants' home addresses. Together with the program, participants received the questionnaire, which they had to fill in and return before starting to work on the programme. After 3 weeks, spending approximately 25 study hours, participants were required to hold the plea for the training task (case Bosmans) that was recorded on videotape. About two weeks later, approximately an extra 15 study hours, participants were required to hold the plea for the transfer task (case Ter Zijde), which was also videotaped. The remaining period of the court practical of about nine more weeks was attended in a more regular classroom setting to promote further elaboration and training of the pleading skills. During this extra period again written legal reports were written and delayed transfer pleas were held at the end; results on these outcomes could be collected for 37 participants.

Participants were urged and controlled to work step-by-step, individually and seriously on the reports they had to send in electronically for rating and logging after each plea, and not to discuss anything with fellow students or teachers in order to maintain independence. The individually delivered reports and pleas were controlled for unlikely similarities and possible fraud. The experimenters extracted the pleading inventories and pleading notes, and forwarded these to the raters, who were almost or just graduated law students. This level of legal expertise was sufficient to just establish the presence of all items (an average of 80 items for each instrument); during development of the instruments all items had been

predefined and weighed by more experienced law teachers. The raters used the instrument to blindly and independently score reports and videotaped pleas. The legal documents and delayed transfer pleas were about various law cases outside the programme, and were assessed by law teachers. An average grade for these reports and pleas was given on a 10-point scale.

Results

Data were analysed with 2 (process worksheets: present vs. absent) \times 2 (worked-out examples: present vs. absent) analyses of variance (ANOVAs), with PWs and WOEs as between-subject factors. Various learning outcomes (on pleading inventory, pleading note, training plea, immediate transfer plea, and delayed transfer plea), various efficiency measures (of the training plea, immediate transfer plea, and overall learning outcome), motivation, mental effort, and time-on-task scores were used as dependent variables. The partial- η^2 statistic was used as an effect size index where values of 0.01, 0.06, and 0.14 correspond to small, medium, and large values, respectively (Cohen 1988).

Motivation, mental effort, and time-on-task

Differential effects of cueing condition on motivation, mental effort and time-on-task scores were analysed to control for possible confounding effects on learning outcomes. Analysis of variance of the motivation scores ($M = 4.30$, $SD = 1.85$, on a 12-point scale) reveals that differences as a function of cueing condition ($F(3, 39) = 2.50$, $MSe = 3.12$, $P = 0.07$, $\eta_p^2 = 0.16$) could be excluded. Average mental effort scores ($M = 5.12$, $SD = 0.76$, on a nine-point scale) also do not differ as a function of cueing condition ($F(3, 39) = 1.19$, $MSe = 0.574$, $P = 0.33$, $\eta_p^2 = 0.08$). Finally, (objective) time-on-task logging data on the training task ($M = 894.93$, $SD = 521.97$, in minutes) do not differ as a function of cueing condition ($F(3, 39) = 0.43$, $MSe = 282006.06$, $P = 0.67$, $\eta_p^2 = 0.04$).

Learning outcomes

Logging shows that participants sent in required reports for pleading-inventory and pleading note and did not skip steps, and left only 7% of these reports blank.

Performance scores on learning outcomes are summarized in Table 1.

The ANOVA comparing groups that did and did not receive PW and/or WOE on the learning outcomes of the training plea revealed a main effect of WOE ($F(1, 41) = 6.36$, $MSe = 143.90$, $P < 0.05$, $\eta_p^2 = 0.15$), indicating better outcomes with WOEs present. The main effect of PW was not significant ($F(1, 41) = 1.00$, $MSe = 143.90$, $P = 0.32$, $\eta_p^2 = 0.03$) for these outcomes. The expected main effect for WOE and the main effect of PW on the outcomes of the product-oriented pleading note subtask were not found (respectively, $F(1, 41) = .24$, $MSe = 316.86$, $P = 0.62$, $\eta_p^2 < 0.01$; $F(1, 41) = 1.14$, $MSe = 316.86$, $P = 0.29$, $\eta_p^2 = 0.03$). With regards to the quality of the process-oriented pleading inventory subtask the expected effect of PW and the main effect of WOE were not significant (respectively, $F(1, 41) = 1.42$, $MSe = 280.77$, $P = 0.24$, $\eta_p^2 = 0.04$; $F(1, 41) = 0.27$, $MSe = 280.77$, $P = 0.61$, $\eta_p^2 < 0.01$). No interaction effects of PW and WOE were found on learning outcomes: training plea scores ($F(3, 39) = 0.53$, $MSe = 143.90$, $P = 0.47$, $\eta_p^2 = 0.01$), pleading note scores ($F(3, 39) = 0.27$, $MSe = 319.55$, $P = 0.60$, $\eta_p^2 < 0.01$), and pleading inventory scores ($F(3, 39) = 0.27$, $MSe = 280.77$, $P = 0.61$, $\eta_p^2 < 0.01$).

Transfer

The expected positive effect of PW on the immediate transfer plea, indicating better transfer with PWs present, could not be found ($F(1, 41) = 0.86$, $MSe = 41.61$, $P = 0.39$, $\eta_p^2 = 0.01$). Both the main effect of WOE ($F(1, 41) = 0.67$, $MSe = 41.61$, $P = 0.42$, $\eta_p^2 = 0.02$) and the interaction effect of PW

and WOE ($F(3, 39) = 0.76$, $MSe = 41.61$, $P = 0.40$, $\eta_p^2 = 0.02$) were not significant.

The ANOVA comparing groups that did and did not receive PW and/or WOE on the *delayed* transfer plea did reveal that students receiving PW ($M = 73.16$, $SD = 4.47$) outperformed those who did not ($M = 68.61$, $SD = 7.63$; $F(1, 35) = 4.41$, $MSe = 40.59$, $P < 0.05$, $\eta_p^2 = 0.15$), indicating the positive effect of PW on delayed transfer. The main effects of WOE ($F(1, 35) = 0.15$, $MSe = 40.59$, $P = 0.70$, $\eta_p^2 < 0.01$) and the interaction of PW and WOE ($F(1, 35) = 0.13$, $MSe = 41.61$, $P = 0.72$, $\eta_p^2 < 0.01$) on these delayed transfer outcomes were not significant. Table 2 also shows that transfer scores for those who did and did not receive WOE during training did hardly differ.

Finally, transfer measures on legal documents written during the remainder of the court practical reveal no significant differences between students who received PW during training ($M = 65.32$, $SD = 6.38$) and those who did not ($M = 61.56$, $SD = 8.50$; $F(1, 35) = 2.28$, $MSe = 59.37$, $P = 0.14$, $\eta_p^2 = 0.07$). The main effects for WOE ($F(1, 35) = 0.00$, $MSe = 59.37$, $P = 0.97$, $\eta_p^2 < 0.001$) and the interaction of PW and WOE ($F(1, 35) = 0.09$, $MSe = 59.37$, $P = 0.77$, $\eta_p^2 < 0.01$) on these outcomes were not significant.

Task efficiency

Efficiency measures are calculated using an extension of the procedure originally described by Paas and Van Merriënboer (1993) for determining instructional condition efficiency. To get insight into the complex relationship between the measures of performance, mental effort, time-on-task and motivation, we extend

Table 1. Performance on pleading inventory, pleading note, first training plea, and transfer plea ($n = 43$)

	WOE				No WOE			
	PW	($n = 10$)	No PW	($n = 9$)	PW	($n = 12$)	No PW	($n = 12$)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Pleading inventory	34.75	21.91	25.67	22.87	23.20	7.91	19.64	10.21
Pleading note	63.80	20.59	54.78	16.28	58.05	15.91	54.95	18.14
Training plea	72.85	9.52	66.28	14.54	60.50	6.07	59.45	15.30
Immediate transfer plea	58.85	5.50	55.17	6.92	55.40	5.35	55.27	7.65

WOE, worked-out example; PW, process worksheet

their instructional condition efficiency measure to a four-factor efficiency measure. In formula: 4 factor efficiency (E) = $(P - C - T - M)/\text{SQRT}$ (square root) (4), with P = performance, E = mental effort, T = time-on-task, M = motivation, and 4 = number of factors. Table 3 further explains this formula and summarizes the efficiency measures for the training plea, the immediate transfer plea, and the overall learning outcome, which is the mean score for both training subtasks and plea.

The ANOVA comparing groups that did and did not receive PW and/or WOE reveals main effects for WOE on both the efficiency of the training plea ($F(1, 41) = 10.69$, $MSe = 0.89$, $P < 0.01$, $\eta_p^2 = 0.22$), on the efficiency of the immediate transfer plea ($F(1, 41) = 4.90$, $MSe = 1.11$, $P < 0.05$, $\eta_p^2 = 0.11$), and efficiency of overall learning outcome ($F(1, 41) = 9.68$, $MSe = 0.81$, $P < 0.01$, $\eta_p^2 = 0.20$), indicating higher efficiency with WOE present. No significant main effects for PW ($F(1, 41) = 1.31$, $MSe = 0.89$, $P = 0.26$, $\eta_p^2 = 0.03$, $F(1, 41) = 1.20$, $MSe = 1.11$, $P = 0.28$, $\eta_p^2 = 0.03$, and $F(1, 41) = 2.23$, $MSe = 0.81$, $P = 0.14$, $\eta_p^2 = 0.06$ respectively) or interaction effects for PW and WOE ($F(1, 41) = 0.21$, $MSe = 0.89$, $P = 0.65$, $\eta_p^2 < 0.01$, $F(1, 41) = 0.16$, $MSe = 1.11$, $P = 0.70$, $\eta_p^2 < 0.01$, and $F(1, 41) = 0.18$, $MSe = 0.81$, $P = 0.67$, $\eta_p^2 < 0.01$ respectively) on these efficiency measures were found. No efficiency measures could be obtained for the delayed transfer plea, since mental effort, time-on-task, and motivation were not measured during the remainder of the court practical.

Discussion

We compared the effects of process-oriented worksheets and product-oriented worked-out examples in a

multimedia programme in the domain of law, training the competence of preparing a plea. Our *first hypothesis* was that novice learners would benefit more directly from concrete worked-out examples, which contain a lot of surface features about the task. WOE are supposed to facilitate the interpretation of 'rich', descriptive schemata that enable near transfer on tasks in a similar context, like preparing a plea for another civil law case, and to support product-oriented subtasks. This hypothesis could be partially confirmed. A near transfer effect of WOE could indeed be confirmed by higher scores on the training plea, as well as by higher efficiency scores on the training plea. However, participants receiving WOE did *not* draw up better pleading notes (a product-oriented subtask) than those who did not.

Our *second hypothesis* was that more expert learners start to benefit from more general, process-oriented leading questions, which embody the 'deep structure' of the task (Dufresne *et al.* 1992). PWs are supposed to facilitate the construction of 'broad', prescriptive schemata that enable far transfer on tasks in another context, like preparing a plea for a criminal law case. This hypothesis could be partially confirmed. Contrary to our expectations, neither a transfer effect of PW on the immediate transfer plea (after 2 weeks) nor on pleading inventory (a process-oriented task) outcomes during training could be found. Participants receiving PW did not draw up better pleading inventories (a process-oriented subtask) than those who did not. We did find a far transfer effect for PW on the pleading scores on a delayed transfer plea (after 8 weeks). Participants receiving PW during training in the long run (i.e. after a longer and more extensive training period) appear to hold better pleas for other cases. It should be noted

Table 2. Performance on legal reports (an average score for a pleading inventory and pleading note) and delayed transfer pleas during the remainder of the court practical ($n = 37$)

	PW ($n = 19$)				No PW ($n = 18$)			
	WOE ($n = 7$)		No WOE ($n = 12$)		WOE ($n = 7$)		No WOE ($n = 11$)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Legal reports	65.86	6.47	65.00	6.60	61.14	8.47	61.82	8.93
Delayed plea	72.14	5.67	73.75	3.77	68.57	8.52	68.64	7.45

WOE, worked-out example; PW, process worksheet

Table 3. Efficiency measures* for training plea, immediate transfer plea, and overall learning outcome ($n = 43$)

	WOE				No WOE			
	PW ($n = 10$)		No PW ($n = 9$)		PW ($n = 12$)		No PW ($n = 12$)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Training plea	0.62	0.81	0.43	1.21	-0.19	0.65	-0.66	1.04
Immediate transfer plea	0.51	1.06	0.28	0.84	-0.08	0.79	-0.57	1.35
Overall learning	0.65	0.85	0.35	0.97	-0.10	0.60	-0.64	1.09

*Instructional efficiency measures were calculated using mental effort (E), time-on-task (T), motivation (M) and performance (P). First scores on these variables were transformed to z-scores. The grand mean is used for calculation, through which the mean z-score for every condition can be determined. These mean z-scores (can not be graphically represented) form a four-dimensional coordinate system. The relative condition efficiency is calculated as the perpendicular distance from a data point in the coordinate system to the line $P = (E+T+M)$. Calculation of E is done, per participant, with the following formula:

$$E = \frac{\text{performance} - \text{mental effort} - \text{time-on-task} - \text{motivation}}{\sqrt{4}}$$

Equal performance (P) and $(E+T+M)$ scores yield an instructional efficiency of zero, a neutral score. When $P > (E+T+M)$, the instructional material is efficient because $(E+T+M)$ is lower than might be expected on the basis of observed performance. When $P < (E+T+M)$, the material is not efficient because $(E+T+M)$ is higher than might be expected on the basis of observed performance. WOE, worked-out example; PW, process worksheet

that it is unclear which proportion of the difference on the delayed transfer plea are to be attributed to case-type (both transfer pleas were about non-civil law cases) and which to delay (elapsed time for retention). The main question that immediately pops up after finding this mixed far transfer result about PW is: Why did we only find a transfer effects of PW after 2 months of training, and not after two weeks already? There are a number of possible explanations that require further study.

First, high *variability of practice* is an essential element for far transfer to occur (e.g. Paas & Van Merriënboer 1994). The beneficial aspects of PW may only become apparent when students have applied them on a sufficiently large variety of law cases and had ample time to let these problem schema mature or 'sink in' during the court practical. If a high level of schema automation is desired for particular routine aspects, the training task alone may not provide enough practice to reach this level because the responsible learning-process strengthening (Anderson 1983), requires large amounts of repetition. Although additional task training (two additional non-compulsory training dossiers within *Preparing a plea*) was available, logging shows that only few students made use of it. However, the minority of participants (7 of 43) that did spend more

than the average time ($M = 27.49$; $SD = 75.54$, in min) on these non-compulsory training dossiers, did draw up better pleading-inventories ($t(42) = 3.50$, $P < 0.01$ (two-tailed)) and had higher overall learning outcomes ($t(42) = 2.08$, $P < 0.05$ (two-tailed)). These differences could not be attributed to cueing condition ($F(3, 39) = 0.49$, $MSE = 5921.10$, $P = 0.69$, $\eta_p^2 = 0.04$).

Second, performance scores on the pleading inventories of the training task indicate a very result-oriented (or product-oriented way) learning attitude of participants. Product-oriented WOE can then be expected to provide best support. Students seem 'calculated learners' who only want to invest time in products that will get graded, and not in the preparatory, more process-oriented tasks, which could eventually lead to better learning products on the long run. We did advise participants to take all intermediate documents (like the pleading inventory) seriously, but they knew these would not get graded. Scores on pleading inventory ($M = 25.35$, $SD = 16.76$), which students do not consider a necessary outcome, and pleading notes ($M = 57.35$, $SD = 17.69$), which are required to hold a plea, are positively correlated ($P < 0.01$). This indicates that the quality of a pleading note does improve with the quality of this preparatory step, although generally

students do not seem to take preparation very seriously when it does not get graded. Scores for pleading inventory and pleading note differ dramatically, which is confirmed by a *t*-test ($t(42) = -11.82, P < 0.01$, two-tailed). Apparently, only the tail wags the dog; this impression was confirmed by several staff members of court practicals in the Netherlands. Since students across *all* conditions scored poorly on the pleading inventory, it is hard to find a beneficial effect for PW here.

Third, the *timing of cueing* formats was not taken into consideration in this study. According to ISD models, like 4C/ID (Van Merriënboer 1997), procedural information ('how to' instructions, such as leading questions in a PW), that is necessary to perform the consistent, routine aspects of learning tasks (like a pleading inventory) should be made available in time. Procedural information is best presented 'just-in-time' on learner demand during training, and not 'just-in-case' at the start of training the subtasks (as was the case for this study). Another study adding learner control to cueing (Hummel *et al.* in press) clearly shows that this extra quality further increases effects of cueing on learning outcomes on both the training and transfer task.

Finally, this study makes clear that further research on task-valid cueing in *authentic learning environments* is timely and promising. Although it does require extra organizational effort and time to conduct such real world research (Robson 2002), the findings show that instructional techniques to facilitate schema-based learning can be reliably compared in controlled authentic settings with training tasks of longer duration. It appears feasible to study competence-based training with relatively long, ill-structured and realistic problem-solving tasks, which are directly transferable to professional practice. The instructional method to combine product-oriented WOE to support near transfer and process-oriented PW to support far transfer has been applied in multimedia programs in a variety of domains. We hope that results of this study can be further examined and extended to other domains that share the same type of problem-solving ontology as for law (i.e. one based on heuristic rules and checkpoints, rather than on strict algorithmic rules and procedures). It remains uncertain if results can be replicated in domains with dissimilar ontologies.

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