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The Impact of Instructional Conceptions on the Use of Adjunct Aids

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Studies on the effects of adjunct aids have generated mixed results. The lack of learners' (adequate) use of adjunct aids has been argued to be one of the major reasons for these mixed results. This study investigates the factors that affect the first step in using aids, i.e. paying attention to them. It is explored whether students' instructional conceptions, more specifically conceived functionality of adjunct aids, affect their use, or whether features of the aids themselves are more influential. After assessing students' instructional conceptions, 255 participants randomly distributed over one control condition or seven experimental conditions studied an instructional text on a computer screen. Conditions differ with respect to the number and nature of adjunct aids. The access of the adjunct aids was monitored. Results show no impact of conceived functionality. The number and type of aids inserted, however, seems to affect the frequency adjunct aids are accessed as well as the proportion of the total study time devoted to the adjunct aids.

Keywords: Adjunct aids, instructional conceptions, tool use, adjunct questions, figures, examples, textbooks, use of instructional interventions.

Instructional interventions and more specifically adjunct aids in textbooks are not always used as intended by the designer. In view of analysing the factors that determine the use of instructional interventions, in

this study attention paid to adjunct aids in terms of accessing them and spending time on them is investigated.

Adjunct aids in textbooks have been intensively studied the last decades (see Grabowski, 2004; Hamilton, 1985, Rothkopf, 1996). Adjunct aids are instructional interventions inserted in a text to support the processing of that text. Typical examples are advanced organizers and inserted questions. Although a one-to-one relationship between adjunct aid and type of cognitive processing is not assumed in research on adjunct aids (Kealy, Bakriwala, & Sheridan, 2003), a particular adjunct aid is generally expected to induce a particular kind of cognitive processing. For instance, advanced organizers are expected to support students in linking their prior knowledge with new information in the textbook. Another typical example is the differential effect of high- versus low-level questions whereby high-level questions have regularly been found to be more demanding but also more effective than low-level questions because they induce reviewing and reorganisation (e.g., Rouet & Vidal-Abarca, 2002). Mayer has contributed greatly to research on adjunct aids by elaborating his 'selection – organization – integration'-model or SOI-model. This model helps to identify the primary function of an adjunct aid. The SOI-model (Mayer, 1996) specifies three main cognitive processes in learning: selecting (S), organizing (O), or integrating (I) new information.

While in many studies positive learning effects of adjunct aids have been ascertained, numerous studies yielded unexpected effects. Two types of conditions can be identified as determinants of the effectiveness of adjunct aids (Perkins, 1985). First, adjunct aids can be effective only when actually functional. In other words, an adjunct aid is only effective if the aid helps the members of the target group to accomplish the learning task at hand. André (1979) points out that an adjunct aid is functional only when inducing adequate cognitive processing. For research on inserted questions, he concludes (p. 298): "Only when the configuration of the system is such that the questions lead the learner to process the materials in ways he would not otherwise have done will questions influence learning and retention and transfer." (p. 298). Schnotz and Bannert (2003) specify that not all members of the target group may need an adjunct aid: "pictures facilitate learning only if individuals have low prior knowledge and if the subject matter is visualized in a task-appropriate way" (p. 154).

A second type of condition is related to the use of the aids by the students. It has been reported that students sometimes do not use the adjunct

aids or if they use them, they use them not as intended by the designers. Peeck (1993) for instance, observed poor effects of illustrations and attributed this finding to insufficient knowledge of students about how to use them for their learning. Elen (1995) investigated the differential effects of different approaches to highlight main points in instructional texts. In attempting to explain the absence of effects, retrospective interviews revealed that students did not use the highlighted main points because they mistrusted them. For distance teaching instructional materials, Martens, Valcke, Poelmans, and Daal (1996) demonstrated that students use support devices differently than intended by the developers. The observation is also typical for so-called open learning environments. Students do not maximally benefit from the tools in such environments because they use these tools sub-optimally or not at all (Aleven, Stahl, Schworm, Fischer, & Wallace, 2003). In other words, due to inappropriate use or lack of use of tools by students, open learning environments have been found to be efficient and effective as expected (e.g., Bromme & Stahl, 2003; Oliver & Hannafin, 2000).

If use of instructional interventions is so crucial, it then becomes important to identify as precisely as possible the factors that affect that use. A first step in the use is paying attention or actually accessing the aid. Both learner and adjunct aid factors have been argued to play an important role in this respect. While being fully aware that accessing an aid is only a prerequisite for using the aid as intended and that even using an aid does not guarantee that the aid will have a positive effect on learning, this contribution aims at analysing the impact of one learner-related and two adjunct aid related factors on the access of adjunct aids in textbooks. The study is seen as a very first step to disentangle the issue of the use of instructional interventions by students.

Learner- and Adjunct Aid Related Factors

The use of instructional interventions has been argued to be affected by a number of student variables such as prior knowledge, metacognition and motivation (Clarebout & Elen, 2006). In this contribution one of the metacognitive variables, instructional conceptions is focussed upon. Instructional conceptions are learners' ideas about the contribution of general instructional features or specific instructional interventions to learning (Lowyck, Elen, & Clarebout, 2004). In line with the mediating paradigm 'instructional conceptions' have been argued to moderate the use of instructional interventions (Clarebout & Elen, 2006; Elen &

Lowyck, 2000). Elen and Lowyck (2000) showed that students have very specific ideas about the possible functions of specific delivery media and specific instructional interventions. Similarly, Salomon (1984) reported that students' ideas about television and printed learning materials affect how much mental effort is invested. It is suggested that particular conceptions may result in quantitatively and qualitatively different uses of instructional interventions in general and adjunct aids in particular. The introduction of the notion of instructional conceptions is in line with the mediating paradigm. This paradigm claims that students do not react to objective or nominal instructional stimuli (Rothkopf, 1968, 1970) as constructed by the teacher or designer (e.g., Anderson, 1989; Doyle, 1977; Entwistle & Tait, 1990; Trigwell & Prosser, 1991; Winne, 1982; Winne & Marx, 1980, 1982) but to transformed, i.e., interpreted stimuli. Consequently, discrepancies in functionality attributed to instructional interventions by designers and learners may lead to a mismatch and sub-optimal use. Instructional interventions may have been neglected by learners, or used in ways that deviate from instructional designers' intentions. Whereas, for instance, designers may insert a pre-question merely as an illustration of an interesting test item, André (1979) found that learners generally use that question not as illustrative but as indicative of the high importance of the item. Similarly, Marek, Griggs, and Christopher (1999) revealed that students' conceptions of a given adjunct aid may influence its use. Respondents in this study indicated a weak inclination to use adjunct aids since these aids require a more elaborate study pattern. The studies of André (1979) and Marek et al. (1999) illustrated that students' instructional conceptions may moderate the effect of the learning environment, and therefore become an important variable. Instructional interventions seem effective only if learners act in accordance with the intentions of the instructional designer, and make use of these interventions (e.g., André, 1979; Butler & Winne 1995; Winne & Marx, 1982).

While in recent research most attention has been devoted to identifying factors at the learner side that affect the use of adjunct aids, at this stage of the research it can not be excluded that features of the adjunct aids themselves rather than learner-related factors mainly affect their use. Possible features are the amount and nature of adjunct aids in an instructional text. No empirical studies seem to have been undertaken to directly investigate the concrete relationship between specific features of adjunct aids and their use.

In this study, both explanations were investigated. Learner-related factors were investigated by studying the impact on the use of adjunct aids of instructional conceptions, more specifically conceived functionality. In contrast to previous studies based on survey-data (e.g., Martens, et al., 1996) or thinking aloud protocols (Schnotz, Picard, & Hron, 1993), the experimental approach in this study provides a direct test of the impact of instructional conceptions. Furthermore, this study differs methodologically from previous ones on adjunct aids in that the actual rather than the reported use of adjunct aids was recorded. This is important because Winne and Jamieson (2003) -amongst others- have reported that students' self-reports about studying do not accurately reflect their actual study behaviour.

At the side of the adjunct aids themselves, we studied the impact of the number and the nature of adjunct aids on their use. It is assumed that the probability of adjunct aid use decreases with an increasing number of aids and that the use of adjunct aids is also related to the nature of these aids. In this study figures, examples, and questions were used. These adjunct aids were selected because they have already intensively been studied. Inserted questions, examples and figures (pictures, images, and diagrams) have attracted much research attention. In several studies, André (1979) has investigated the differential learning effects of both pre- and post-questions (see also Hamaker, 1986; Pressley, Tanenbaum, McDaniel, & Wood, 1990). Research on examples both in the context of text comprehension (Wade, 1992) and concept learning (Klausmeier, 1980) has revealed the potential benefits as well as the drawbacks of clarifying more abstract materials by referring to concrete instances. And, while the use of pictures has already been advocated by Comenius and brought into practice in his book Orbis Sensualium Pictus (Murphy, 1995), the introduction of computers and research on multimedia have given rise to a renewed interest in the relationship between textual and pictorial or graphical information in a text (e.g., Balluerka, 1995; Robinson, Corliss, Bush, Bera & Tomberlin, 2003; Schnotz & Bannert, 2003).

In summary, the present contribution discusses an experimental study that aims at answering two research questions with respect to the use, or more specifically, the access of adjunct aids. The first and central question pertains to the impact of instructional conceptions on the use of adjunct aids. The second question relates to the impact of the amount and nature of the aids on the use of adjunct aids.

METHOD

Participants and Design

Research participants were 255 (221 female, 34 not specified) students attending undergraduate classes at a public university in central South Africa. Due to technical problems a complete dataset is available for only 203 students. All students were majoring in education and volunteered to participate in the study. Students could gain a limited number of extra points by participating in the study.

All respondents were randomly assigned to one out of eight conditions in an experimental study with amount of aids (five, ten, or fifteen), type of aids (questions, examples, or figures) and results on the conceived functionality scale (see further) as independent variables and use of adjunct aids as dependent variable. In order to ensure a sufficient number of participants in each condition a full 3x 3 design could not be implemented.

TABLE 1
Control and experimental conditions.

	Examples	Questions	Figures	N
Condition 1 (control)	0	0	0	31
Condition 2	5	0	0	31
Condition 3	0	5	0	31
Condition 4	0	0	5	31
Condition 5	5	5	0	32
Condition 6	5	0	5	32
Condition 7	0	5	5	32
Condition 8	5	5	5	35

All students studied an instructional text on a computer screen. The eight conditions differ with respect to (a) the number of adjunct aids inserted (0, 5, 10, or 15 adjunct aids), and (b) the nature of the adjunct aids inserted (examples, questions, or figures) (see Table 1). In the first condition, the

control condition, no adjunct aids were added. In conditions 2, 3, and 4, five adjunct aids were inserted: five examples in condition 2, five questions in condition 3 and five figures in condition 4. The instructional text in conditions 5, 6 and 7 contained 10 adjunct aids with in each condition two sets of five adjunct aids. In condition 5, 5 examples and 5 questions were inserted; in condition 6, 5 examples and 5 figures, and in condition 7, 5 figures and 5 questions. Finally, in condition 8, 15 adjunct aids were inserted in the instructional text: 5 examples, 5 questions, and 5 figures.

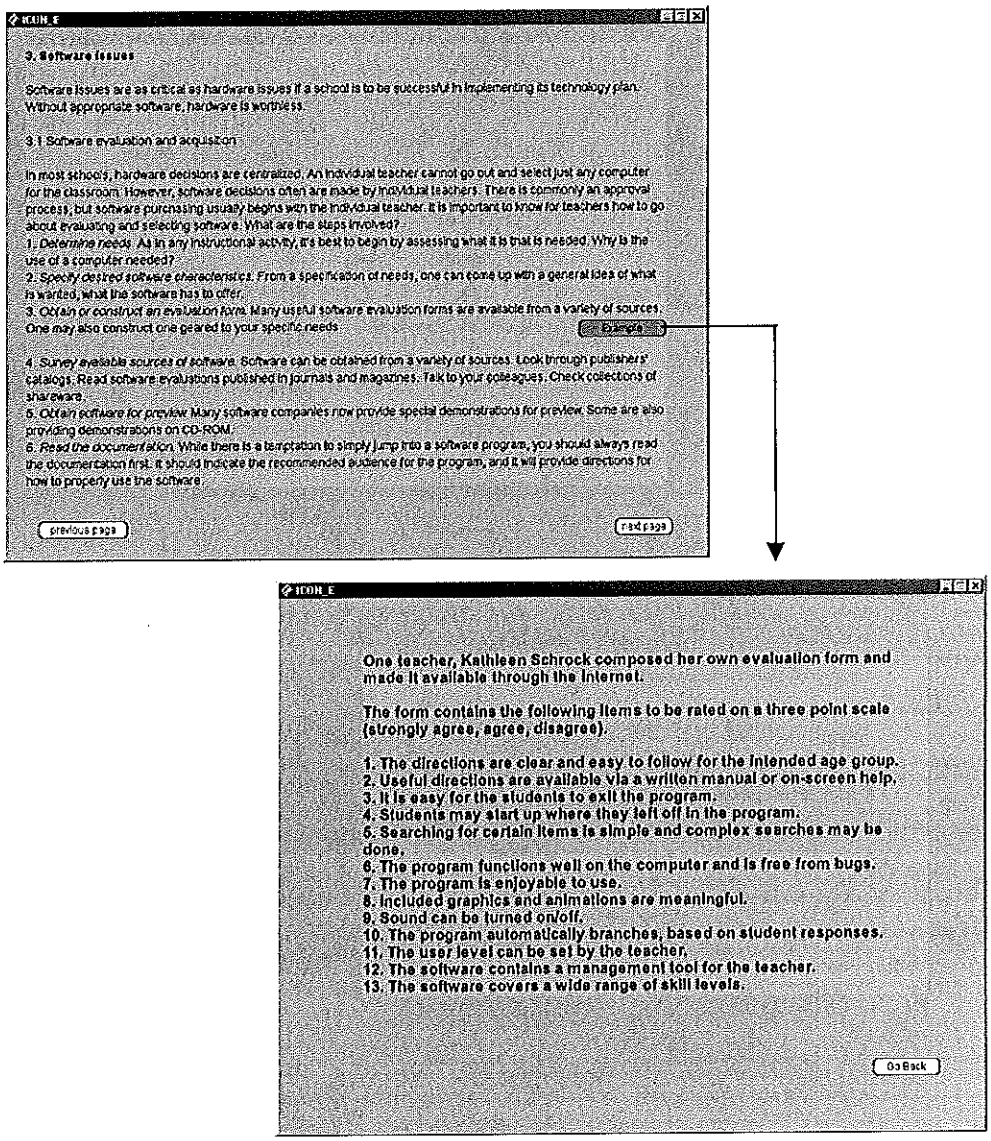

FIGURE 1
Example of computer screen and related adjunct aid.

Materials

Instructional text

The instructional text was a 6446 word passage (7182 words in the version with all three types of adjunct aids) adapted from a chapter on technology management by Newby, Stepich, Lehman, and Russell (1996). The different versions of the computerised texts were developed using Macromedia Director 8.5. This text was selected by the educational technology lecturer for this group of future teachers He judged the text to be appropriate in reading level, and relevance for the students, given recent plans of the South African department of education. Distributed over 21 screens, the text discusses various issues with respect to the integration of ICT in schools. In a first section the need for a technology plan is discussed. Hardware and software issues are discussed in the second and third section, while the final section describes personnel issues. On the last screen, a summary concludes the text.

Adjunct Aids

Students gained access to the adjunct aids by clicking on a labelled button. The integration of the adjunct aids is based on the following considerations. To ensure balance, adjunct aids were evenly spread over the 21 screens with a maximum of 1 adjunct aid per screen (e.g., two related screens are displayed in Figure 1). This means that in condition 8 with 15 aids, there were 15 computer screens with an aid and 6 screens without an aid. To ensure comparability of the eight conditions and to avoid interfering sequence effects, an adjunct aid was always linked to the same computer screen and different types of adjunct aids were inserted in the same sequence. These considerations resulted in a distribution of the adjunct aids as

TABLE 2
Distribution of adjunct aids over the text.

	Text screen																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Questions	x				x				x				x				x				
Figures		x				x				x				x				x			
Examples			x				x				x				x				x		

outlined in Table 2. As can be seen and only for the relevant conditions, adjunct questions were accessible through the 1st, 5th, 9th, 13th, and 17th screen; figures were accessible trough the 2nd, 6th, 10th, 14th, and 18th screen, and examples could get accessed through the 3rd, 7th, 11th, 15th, and 19th screen.

Questions were inserted in view of supporting information selection activities of students. Questions are assumed to trigger students to think more deeply about an information element or to link a specific element to their person. In the conditions with inserted questions (conditions 3, 5, 7, and 8) students could access five inserted questions. For instance, the following question was added to the screen in which different LAN-configurations were presented: "If your principal would ask your advice on the installation of a local-area-network (LAN), what would be your arguments in favour of a client-server model?".

As suggested by the SOI-model, figures can have two main functions (Mayer, 1999). If a figure is more a graphic representation organization processes are supported. Illustrations may also support integration processes. In the conditions with figures (conditions 4, 6, 7, and 8) students could access five pictures by clicking on the figure button. None of the pictures was purely decorative. Three figures illustrated the information on the computer screen by repeating part of the textual information in a pictorial way (e.g., see Figure 2), whereas two others highlighted in a diagram the structure of the text on the screen that contained the figure button (e.g., see Figure 3).

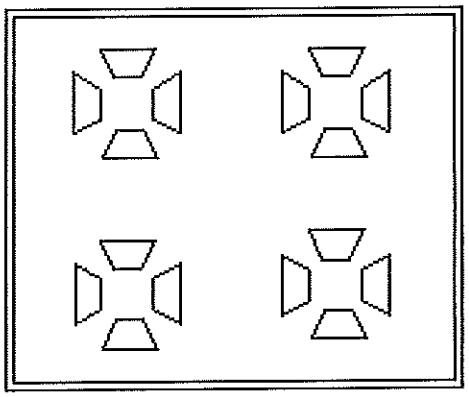

FIGURE 2
Figure added to text explaining computer lab lay-outs.

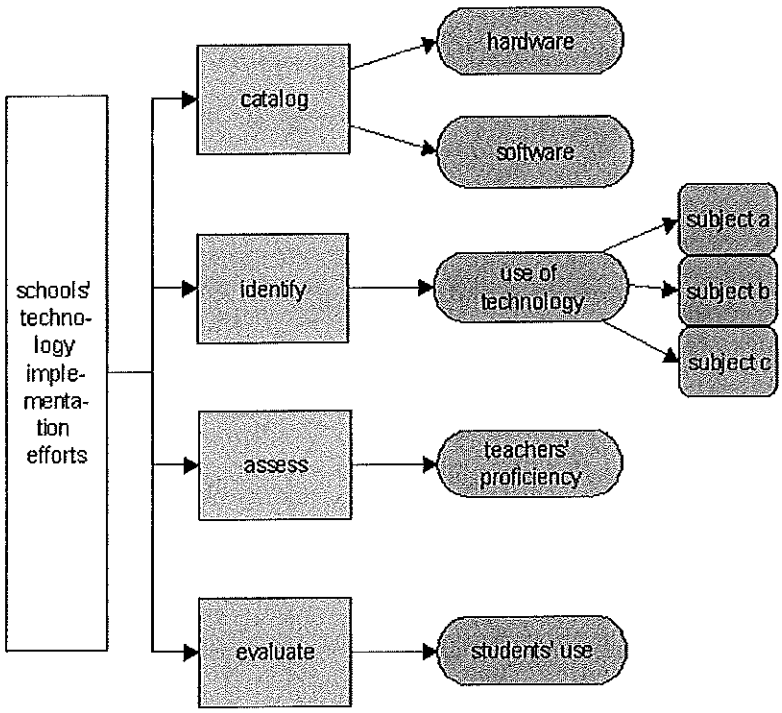

FIGURE 3
Figure added to screen discussing technology implementation plans.

Examples may support learners in connecting their own prior knowledge with the new information. In the examples-conditions (conditions 2, 5, 6, and 8) students could access five examples that further contextualized the more general information in the text. Figure 1 presents an example in which a concrete software evaluation form is presented. The examples were constructed by selecting the element in the text that was most difficult to understand. For instance, an excerpt from a mission statement was added to explain the meaning of the concept 'mission statement'.

ICON-questionnaire

In order to assess instructional conceptions the I(nstructional)CON(ceptions)-questionnaire was used. This questionnaire was elaborated and field-tested in various countries (Clarebout, Elen, & Sarfo, in press). In this study, only the second of the two parts was used. The first part contains 23 items and addresses general conceptions of students about education goals and the distinctive roles of students and instructional agents. The second part aims at assessing the conceived functionality of specific instructional interventions, in this case the three adjunct aids investigated: examples, questions,

and figures. For each intervention, students have to indicate their agreement with 8 statements on the functionality of that particular intervention by using a 6-point Likert-type scale (totally disagree; disagree; somewhat disagree; somewhat agree, agree, and totally agree). Examples of items include: "According to me examples in a course text direct students' attention to relevant features." and "According to me questions in a course text encourage student to practice". The total number of items in the second part of the ICON-questionnaire is 24. Analyses (see Clarebout et al., in press) revealed that with these 24 items a 'conceived functionality' scale with high internal consistency (Cronbach alpha = .95) could be constructed. Given this high internal consistency, this scale was regarded capable of providing reliable assessment of conceived functionality.

Log-files

All the actions of the participants were logged in an Access database for further analysis. The file contains an identification number for each respondent and information on whether and at what time a text screen or aid is accessed by the respondent. Data from the log files were used to calculate the number of times (specific) adjunct aids were used, the time spent on working with the aids and the proportion of the total study time devoted to the adjunct aids. Based on the data in the database different aspects of use could be calculated both for each individual adjunct aid and all aids inserted in the text: the number of times adjunct aids were accessed; the duration adjunct aids were consulted, and the proportion of the total study time devoted to adjunct aid(s).

Procedure

All participants were present in two sessions. In the first session instructional conceptions were assessed through means of the ICON-questionnaire. Respondents could take as long as necessary to complete the instrument. Administration of the ICON-questionnaire took approxiamtely ten to fifteen minutes. During the second session one week later, groups of up to 30 students studied the instructional text on a computer screen in one of the 8 conditions. Participants were randomly assigned to one of the conditions (see Table 1). The second session took about 50 minutes. Five minutes were used for explaining the procedures and how to handle the text on the screen. For this purpose a standardized PowerPoint presentation was used. Students were told that they could study at their own pace, could freely move around in the instructional text and that they would be informed

when 40 minutes had passed. Students thus could access a particular aid more than once.

Data Analyses

The research questions in this study relate to the impact of conceived functionality (i.e., instructional conceptions), and condition (i.e., type and number of adjunct aids) on the frequency of access to adjunct aids and the proportion of total study time devoted to adjunct aids (i.e., use of adjunct aids). Given intercorrelations between these dependent variables, this question was analyzed by a two-way MANOVA with the statistical package SPSS. In view of transparent interpretation, for the instructional conceptions three equally large groups of students were created with respectively low, middle and high scores on the conceived functionality scale. Results of MANOVA were further analyzed by studying the 'test of between subjects effects'. In all cases DUNCAN was selected as the post-hoc test, an alpha level of .05 was used for all statistical tests, and effect sizes were calculated.

RESULTS

Results on the second part of the ICON-questionnaire reveal that overall students conceive the functionality of adjunct aids to be relatively high (M=4.81; SD=.69).

In order to get a good understanding of the (quantitative) use of the adjunct aids, the log-files were analyzed to reveal (a) the total number of times the adjunct aids were accessed, and (b) the proportion of the total study time devoted to the adjunct aids. Table 3 summarizes the main results for all the conditions.

TABLE 3
Summary of log-file data.

Variable	M	SD
Total access adjunct aids	5.63	5.32
Total time text	36'02"	9'4"
Total time adjunct aids	1'43"	1'48"
Proportion adjunct aids / total time	4.65	4.51

A MANOVA reveals an overall effect of condition (Wilks' Lambda= .520; F(14,356)= 9.826; p≤.05; eta²= .279) but no effect of conceived functionality nor any interaction effect. More specifically, the test of between subjects effects reveals an effect of condition for the frequency of access (F(7, 202)= 16.419; p≤.05; eta²=.391) as well as for the proportion of study time devoted to the adjunct aids (F(7, 202)= 16.419; p≤.05;

TABLE 4
Homogeneous groups with respect to frequeny of access and proportion of study time devoted to adjunct aids.

Frequency of acces of adjunct aids					
Condition	N	Subset 1	Subset 2	Subset 3	Subset 4
1. No adjunct aids	27	.00			
2. 5 examples	27	2.22	2.22		
3. 5 questions	27		3.67		
4. 5 figures	26		4.31		
5. 5 examples and 5 questions	26			7.27	
7. 5 questions and 5 figures	28			8.68	8.68
8. 5 ex., 5 quest., and 5 fig.	23			9.13	9.13
6. 5 examples and 5 figures	19				10.47
Proportion					
Condition	N	Subset 1	Subset 2	Subset 3	Subset 4
1. No adjunct aids	27	.00			
4. 5 figures	26		2.33		
2. 5 examples	27		3.13		
3. 5 questions	27		3.18		
7. 5 questions and 5 figures	28			5.57	
8. 5 ex., 5 quest., and 5 fig.	23			7.21	7.21
5. 5 examples and 5 questions	26			7.58	7.58
6. 5 examples and 5 figures	19				8.34

eta²=.360). According to the criteria put forward by Cohen (1988), effect sizes are large to very large in both cases, namely explaining respectively 39% and 36% in the variance. Duncan post-hoc tests reveal 4 homogeneous subsets (see Table 4) for the impact of condition on the frequency of use of the adjunct aids. The control condition without adjunct aids together with the condition with 5 examples belongs to a first group with limited frequency of use. All conditions with five adjunct aids belong to a second, partly overlapping, group with low to medium frequency of access. The third group contains two conditions with 10 adjunct aids (condition 5 with 5 questions and 5 examples, and condition 7 with 5 questions and 5 figures) as well as the condition with 15 adjunct aids (condition 8 with 5 questions, 5 examples, and 5 figures). Finally, there seems to be a partly overlapping group of three conditions with high frequency of access of the adjunct aids. All conditions in which figures are combined with one or two other types of adjunct aids belong to this group.

A slightly different picture emerges when the proportion of study time spent on adjunct aids is examined. Again, Duncan post-hoc tests reveal four homogenous subsets. The condition without aids belongs to a first group. Conditions with five aids belong to a second group. The third group contains the conditions in which a medium to high proportion of study time is spent studying the adjunct aids. Condition 7 (a comination of questions and figures), 8 (a combination of questions, figures, and examples), and 5 (a combination of questions and examples) belong to this group. The group with the highest relative proportion of time devoted to adjunct aids includes the conditions 8, 5, and 6. In all these conditions examples are combined with one or two other types of aids.

DISCUSSION AND CONCLUSION

In this study, the use of adjunct aids was investigated in terms of access to these aids and time devoted to them. The study was launched in order to experimentally test the argument that instructional conceptions affect the use of adjunct aids and, hence, might moderate learning outcomes. When conceiving the study, an alternative hypothesis was not excluded. It was suggested that the number and nature of adjunct aids inserted in a textbook might also affect their use and hence influence learning outcomes. In contrast to other studies on the use of instructional interventions in general and adjunct aids in particular (e.g., Martens et al., 1996) but in line with the

call of Winne (in press) to register actual students' learning activities, access and time spent on the adjunct aids was measured by logging all students interactions with the instructional text.

Log-file data show that overall adjunct aids are not accessed frequently. The mean access frequency of 5.36 is already indicative of this. Moreover, an analysis of the proportion of study time spent on adjunct aids reveals that less than five percent of study time is spent using the adjunct aids. This study, then, confirms the available literature on the restricted use of instructional interventions in learning environments and highlights the need to further study the factors that affect use and non-use of instructional interventions.

In contrast to expectations and the literature on students' conceptions and beliefs (Lowyck et al., 2004; Winne, 1987), however, results provide no evidence that instructional conceptions affect the use of adjunct aids. No effect on the frequency of access of adjunct aids nor on the proportion of study time devoted to adjunct aids could be found of the conceived functionality of adjunct aids as measured through means of the second part of the ICON-questionnaire. This result elicits at least two major questions. The first relates to whether and if so, how instructional conceptions moderate the effects of instructional interventions in general and adjunct aids in particular. One possible answer is proposed by Clarebout, Elen, Léonard, & Lowyck (in press). The answer is based on results of an extensive survey study and inspired by the findings of Sander, Stevenson, King, and Coates (2000) on the role of expectations of higher education students. These authors suggest that use is determined by expectations about the functionality of an instructional intervention within a specific context rather than instructional conceptions themselves. The use of examples is determined not by their conceived functionality but by their expected functionality in a particular section of a textbook. Such instructional expectations may result from the interaction between instructional conceptions and an interpretation of the context. For the study at hand, this would imply that students had low expectations about the adjunct aids not because of a low conceived functionality of these aids but because of their interpretation of the specific context in which they were presented: a research project. This interpretation would be in line with findings of Nolen and Haladyna (1990) about what students believe to be effective study strategies. Such beliefs are related to personal (students' conceptions about the task) and environmental (students' perceptions of teachers' goals) factors. Testing this possible explanation will involve the elaboration of a

valid instrument to assess context-specific expectations about the functionality of instructional interventions.

The results induce a second research question. The absence of a moderating effect of instructional conceptions triggers the question about what factors affect the quantity as well as the quality of the use of instructional interventions in learning environments (see also Clarebout & Elen, 2006). It seems that there is a need for a research agenda in which the various cognitive, metacognitive, motivational, and affective variables, suggested to affect the use, are systematically and interactively investigated. Devices to automatically track students learning activities and interactions with elements of learning environments such as gStudy (Winne, in press) are essential tools in this line of inquiry.

While instructional conceptions does not seem to affect the use of adjunct aids, a strong effect of conditions was found in this study for both frequency of access and for the proportion of study time devoted to adjunct aids. Results in this respect can be summarized as follows. First, it seems that increasing the number of aids may also increase the probability that aids are used and, related to this, that the proportion of time invested in adjunct aids increases. However, this relationship between number of aids and frequency of use and/or proportion of time is not linear. Rather, results seem to suggest that, in order to promote the use of adjunct aids and the time spent on them, a reasonable number of aids is to be inserted. In other words, this study strongly suggests that there is a context-specific optimal number. While it is to be empirically explored what that optimal number could be and how it relates to the length of the text, this study suggests that for a text of about 7.000 words ten adjunct aids is optimal. Inserting more than ten aids does not led to increase of use. Second, not only the number of adjunct aids but also the nature of these aids seems to affect use. Results on frequency of access indicate that students are more inclined to access adjunct aids when figures are also presented. Given the data gathered in this study, an adequate explanation cannot be provided. The broader literature, however, points to possible effects that may explain our findings, namely a 'perceived ease'-effect or a modality effect. With respect to the use of technological devices, the technological acceptance model was found to be a valid predictor of, for instance, software use (Bagozzi, Davis, & Warshaw, 1992). This model suggests that the use of a device is related to its perceived usefulness and its perceived ease of use (Davis, 1989). Given that conceived functionality can be regarded to be an indicator of perceived usefulness, it remains to be explored whether perceived ease may help to explain our findings. In line with figure-ground processes (Winn, 1993), the

modality effect would claim that students are inclined to access those interventions whose format or 'modality' is most different from the remainder of the information. In the context of a text, figures are the more deviating information and hence are accessed more frequently.

Interestingly, while results for frequency of access of adjunct aids indicate that adjunct aids are accessed most frequently in conditions with figures, results on the proportion of time devoted to adjunct aids indicates that most time is spent on adjunct aids in conditions with examples. Most time is devoted when both examples and figures are inserted in the text. In terms of the SOI-model (Mayer, 1996, 1999) and considering that figures in this study have both an illustrative and organizational function, this result suggests that students spent most time with adjunct aids that support the integration of new information in prior knowledge.

In summary, based on a study in which the actual access of adjunct aids was assessed it can be said that the number and nature of adjunct aids are more important with respect to their use than the conceived functionality of these aids. In other words, and contrary to our expectations, the impact of instructional conceptions seems to be limited. While this result points out that more in-depth studies are needed to reveal what factors affect the use of adjunct aids, results may have also been affected by the specific instrument used to measure conceived functionality. While a scale was used with high internal consistency, it must be stressed that only one particular operationalization of instructional conceptions was tested. For instance, results suggest that not conceived functionality but conceived ease is more influential. Similarly, in order to assess instructional conceptions and not learning conceptions in this study, the items in the instructional conceptions questionnaire were not personalized. By doing so, conceptions on the relationship between interventions and learning might have been assessed, while metacognitive conceptions immediately related to the learning of the participants themselves, may have remained unstudied

Another explanation of the unexpected results considers students' motivation. Given the experimental nature of this study, motivation of students may have been sub-optimal. Given such sub-optimal motivation, the impact of instructional conceptions may not have been revealed. Similarly, the fact that a text had to be studied on a computer screen may have altered students regular study strategies and approaches and, hence, may have moderated the potential impact of instructional conceptions. These considerations would suggest that a replication study is needed in a research context with high ecological validity.

By falsifying the effect of instructional conceptions and by suggesting the importance of text-related aspects, this study questions the underlying theoretical framework and calls for a renewed effort to identify, describe and analyze the variables that affect students' use of instructional interventions.

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