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# Instructional Support for Distance Education

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## INTRODUCTION

During the late '90s, distance education and e-learning were believed to be able to solve almost every problem associated with the further qualification of employees in organizations. Distance education was credited with saving costs for companies, by reducing time and expenses for traveling and with flexible time management. Consequently, many companies started programs for distance education. However, after this initial euphoria, several organizations experienced problems with their programs (e.g., Haben, 2002). The costs for distance education courses exploded, employees refused the new style of learning, and the general question arose as to the effectiveness of distance education (see, e.g., Bernard et al., 2004). Looking at the range of distance education courses at this time, one could see that they used a broad variety of technologies to deliver learning contents to the learners, for example, videos, Web pages, dedicate software for learning, Weblogs, wikis, collaboration tools, videoconferencing, chat, and discussion boards. However, in contrast to the variety of technologies available, the instructional design of these courses was elementary and traditional (see Ertl, Winkler, & Mandl, 2007). Many courses offered recorded classroom lectures and streamed them to participants, or they just presented texts or slides in the style of a book. Such courses experienced a lack in acceptance and thus several efforts of distance education failed because the instructional design of these courses was not able to take advantage of the innovative technologies.

## BACKGROUND

To take advantage of the emerging technologies, a new philosophy of learning and teaching is necessary. Moderate constructivist approaches focus on several activities of learners that are necessary for the successful implementation of distance education courses. They build on learners' active knowledge construction and postulate that learning requires learners' active participation. This is in contrast to traditional approaches, which set learners in a receptive role. According to constructivist approaches, learning is mediated by learners' individual prior knowledge, their motivation, and other individual learning prerequisites. Reinmann-Rothmeier and Mandl (2001) describe several key-elements for construction of knowledge according to this philosophy (see also Ertl, Winkler, & Mandl, 2007). They state that a learning process is:

- **Active**, because only active involvement enables learning.
- **Self-directed** and learners have to take active control and responsibility for their learning activities.
- **Constructivist**, which means that learners have to embed new knowledge in their existing knowledge structures.
- **Social** and knowledge acquisition requires a social context.
- **Situated** because knowledge acquisition happens in a specific context and is linked to this context.
- **Emotional**; the emotional component is particularly important for the motivation of the learners.

Besides these constructivist aspects, learning environments require a certain amount of instruction (Ertl et al., 2007; Kirschner, Sweller, & Clark, 2006; Reinmann-Rothmeier & Mandl, 2001). Consequently, learning environments need to find a balance between construction and instruction. This balance can be realized by the design of problem-oriented learning environments (see Mandl, Gräsel, & Fischer, 1998) and case-based learning scenarios (Kolodner et al., 2003). Such learning environments can benefit from new technologies; they can provide tools for supporting the active construction of knowledge (Roschelle & Teasley, 1995), provide an authentic situational context by the display of video cases (CTGV, 1997), enable the social context for spatially-divided learners (Mandl, Ertl, & Kopp, 2006), and motivate learners by the provision of gimmicks and animations (Mayer, Hegarty, & Mayer, 2005). However, none of these benefits are caused by the technology itself—they are introduced by the instructional design of the learning environment including the use of the new technologies.

This chapter focuses on two particular aspects how the instructional design can apply new technologies for the improvement of learning environments: on collaboration-specific methods structuring learners' collaboration, and on content-specific methods that are supporting learners' active construction of knowledge.

## COLLABORATION-SPECIFIC METHODS

Methods for facilitating learners' collaboration may be associated with several tools, particularly software products that aim at enabling collaborative work or at supporting particular collaborative tasks (e.g., collaborative drawing or text editing). These tools can support collaboration between learning partners, yet the fact remains that collaborative skills often do not come naturally to the individual learner and must therefore be acquired (see Salomon & Globerson, 1989). Instructional approaches focusing on the improvement of collaboration often refer to methods such as *scripted cooperation* (O'Donnell & King, 1999). Such scripts sequence learners' work on the task. Furthermore, they may provide roles for the learners and encourage them to apply beneficial strategies for solving a task.

As an example, the MURDER-script (Dansereau et al., 1979; O'Donnell & Dansereau, 1992) is comprised of several different aspects, and will therefore demonstrate the potential elements of scripts and their combination. This script relates to a collaboration process in which learners work collaboratively on text comprehension. It divides the collaborative learning process into six phases that focus on individual as well as on collaborative activities. The first phase relates to learners personal motivation for the task ahead (*M*ood). The second phase focuses on individual text comprehension (*U*nderstand). In the third phase, one partner repeats contents of the text from his memory (*R*epeat) while the other partners try to find difficulties and give feedback ($4^{th}$ phase; *D*etect). In the following, learners reflect and elaborate about the content to link the learning material with their prior knowledge ($5^{th}$ phase; *E*laborate). Finally, they check their work against the original text material (*R*eview, $6^{th}$ phase). Learners may repeat these six phases for several text paragraphs and for each cycle, a different learning partner takes the role to repeat the text contents.

Technologies can integrate such scripts into collaborative learning environments. They may structure the collaboration process or the proceeding in the work on the task. Baker and Lund (1997), for example, report a script, which specifically directed the collaboration process. Their learning environment provided a shared graphics editor for working on a collaborative product and the instructional design added several *speech act buttons* to this editor. Each time a learner had made changes to the collaborative product, the learning environment required both partners to agree on these changes before continuing. They were required to demonstrate this by pressing the respective speech act buttons. The intention of this mechanism was that both learning partners increased their grounding (Dillenbourg & Traum, 2006) and their collaborative commitment to the joint product (Baker & Lund, 1997).

Ertl, Reiserer, and Mandl (2005) showed a different example for scripting in distance education using a video-conferencing scenario. The aim of this script was to facilitate learners during the task of collaborative teaching. This script structured the collaborative proceeding on the task, the roles of the learners, and the application of beneficial strategies regarding the collaborative negotiation. Therefore, the script assigned two different roles to the learners, the role of a teacher, and the role of a learner. Furthermore, it divided the collaboration process into four different phases. Learners worked with a shared application in this scenario, and this application offered learners a space for written externalizations. Furthermore, the application was pre-structured with instructional elements that guided learners according to the script. In the first phase, the participant in the teacher role explained the text material while the partner in the learner role asked comprehension questions. In the second phase, the learner rehearsed the concepts acquired and fixed important aspects in the shared application. The teacher supported the partner and clarified misinterpretations. In the third phase, both partners reflected individually, and in the fourth phase, they discussed the learning material. In this phase, the learner also noted important aspects in the shared application. After these four phases, learners switched their roles and continued with another text.

Results of the study showed that the learning environment with the script was able to facilitate learners' negotiation with theoretical concepts during collaboration. With respect to the individuals' learning outcomes, the script particularly facilitated learners in the learner role. They acquired more knowledge during collaboration than learners without a script (see Ertl, Reiserer, & Mandl, 2005). Other studies also report beneficial effects of scripts in distance education courses. These were related to the learning processes (Baker & Lund,

*Table 1. Taxonomy of support methods with different goals*

| Goal of support | Collaboration-specific methods | Content-specific methods |
|---|---|---|
| *Improving collaborative processes* | Scripts | |
| *Understanding impact factors* | | Simulations |
| *Understanding structures* | | Templates |
| *Understanding relations* | | Conceptualization tools |

1997; Weinberger, Ertl, Fischer & Mandl, 2005) as well as to the individuals' outcomes (Rummel & Spada, 2005). Scripts may improve general processes of collaboration (Baker & Lund, 1997), lead to a more homogeneous work on the task (see Weinberger, 2003) and to the acquisition of beneficial collaboration strategies (Rummel & Spada, 2005).

## CONTENT-SPECIFIC METHODS

Content-specific methods rely on particular affordances of the course's content domain. They may provide domain categories or ontologies for the learners (see, e.g., Ertl, Fischer, & Mandl, 2006), facilitate the visualization of conceptual relations (see Fischer, Bruhn, Gräsel & Mandl, 2002), or provide simulations or visualizations which help learners to understand particular mechanisms (see Roschelle & Teasley, 1995). Content-specific methods aim for support at a conceptual level and try to facilitate learners' understanding of particular conceptual aspects, relations, or mechanisms of the content domain (see Table 1).

Content-specific methods often rely on a particular representation of important content structures. Zhang and Norman (1994) postulate that this representation of content has an influence on learners' ability to deal with the content. If a method changes the representation of the content then it might be that learners perceive this content in a different manner. This may facilitate as well as impede learning—depending on the match between the representation and the learners' cognitive structure (see Zhang & Norman, 1994). This means that the content structure remains the same (it is isomorph) but the way in which it is presented changes. A rather simple example for this mechanism would be to provide a diagrammatic representation instead of a textual description (see, e.g., Larkin & Simon, 1987). The representation can make important task characteristics salient and function as a representational guide for the learners (see Suthers & Hundhausen, 2003). There is a broad variety of methods and tools for this kind of facilitation (see Löhner & van Joolingen, 2001). They offer different amounts of facilitation to the learners, and they vary with respect to the degrees of freedom the learners have when working with them.

In distance education, one has to distinguish between tools, which enable content-specific facilitation, and the instructional design, which applies the tools to a particular context and provides the facilitation. Powerful tools may offer many possibilities and much freedom to the learners. However, this may be too complex for the learners, who may not have the cognitive ability to apply it correctly and thereby suffer from cognitive overload (see Sweller, van Merrienboer, & Paas, 1998). Consequently, it may be too complex for beneficial activities (see Dobson, 1999) and negate the potential facilitation effect. The instructional design of a distance education course should therefore consider the skills and the prior knowledge of the learners (see Mandl, Ertl, & Kopp, 2006; Shapiro, 2004) and aim for a balance between learners' experiences and the demands of the tools.

In the following, we will describe briefly different forms of content-specific support:

- Tools for simulations (see Roschelle & Teasley, 1995) allow learners to *simulate* scientific processes. The instructional design of these tools is such that the learner can simulate a process according to various parameters. The particular tools for simulations are modeled specifically for this one purpose and might also include visualizations or animations of these processes. Learners can modify the parameters of the simulation and observe the results of this change in the simulation. Thus, simulations aim at understanding the influence of particular factors on a whole (simulated) system.
- Templates are different from simulations in that they *pre-structure* a content domain (see Brooks & Dansereau, 1983; Ertl, Fischer, & Mandl, 2006; Suthers & Hundhausen, 2003). In this case, the tool provides the features to create templates, and the instructional design specifies the contents of these templates. It provides categories that are particularly important for content-specific negotiation and often uses tables for their representation. These tables provide empty spaces for the learners which help them to focus on the important categories. However, learners cannot change the structure of the tables and model new relations. Consequently, templates aim at internalizing the structure of a content area.
- Conceptualization tools allow the visualization of connections between different concepts within a subject matter. They enable learners to illustrate connections between concepts and theories by creating a mind map or a similar diagram. The tool provides the concepts and various types of connecting lines that are then sorted and put together to demonstrate the connections. Learners may thereby create their own representation, but the process is supported by the pre-existing elements used (see Fischer et al., 2002; Suthers & Hundhausen, 2003). Consequently, conceptualization tools are intended to facilitate a deeper understanding of the relationships within a particular content area.

Ertl, Reiserer, and Mandl (2005) present an example for a content-specific method in a distance education course in the style of a template. This template aimed at facilitating learners' learning of text material. It focused learners on important aspects of theories, particularly on the categories of theory concepts, evidence, and personal elaborations with respect to consequences and learners' individual opinion. They used a shared application for providing the template to the learners. The instructional design provided a table with four cells headed by the respective category names. Furthermore, it anchored the rather broad categories by different prompts in each table cell.

Results of the study show that this template provided several benefits for the learners. They reached a higher score in the category of evidence, and they provided more personal elaborations (see Ertl, Reiserer, & Mandl, 2005). Thus, the template was able to direct the learning process not only to the memorization of facts, but also on the personal contextualization of these facts. Moreover, several other studies have shown beneficial effects of content-specific methods in the context of distance education (see Ertl et al., 2006; Fischer et al., 2002; Roschelle & Teasley, 1995; Suthers & Hundhausen, 2003). Roschelle and Teasley (1995) report beneficial effects of simulations for transactive discourse and knowledge co-construction. Ertl et al. (2006) present a template, which provided benefits for learners' collaborative learning process as well as for their individual knowledge acquisition. Suthers and Hundhausen (2003) reported that a template had facilitated the learners to draw relations between theoretical concepts and evidence. Furthermore, Fischer, Bruhn, Gräsel, and Mandl (2000) found that conceptualization tools homogenized collaborative learning processes.

## FUTURE TRENDS

Studies which compared learning environments with a sound instructional design and traditional courses report an increased quality of education, a more active role of the learners, and more motivated learners if they were working in the well-designed learning environment (see, e.g., Hiltz, 1997; Lehtinen, 2003). In contrast, studies which just compared different technologies were hardly able to find any beneficial effects of the technologies for learning (e.g., Clark, 1994; Salomon, 1984; Schweizer, Pächter, & Weidenmann, 2001; Storck & Sproull, 1995). This means that distance education courses can provide "powerful learning environments". However, this power comes from the collaborative setting and from their instructional design rather than from technology. The future of e-learning will evoke some kind of consolidation in the field. Distance education courses will be more and more subject to evaluation. This will disclose how far a particular course or technology can provide benefits for the learners.

## CONCLUSION

This chapter dealt with instructional support for distance education courses. This is of particular importance for distance education because many distance education courses have a fairly simple instructional design. They provide either lectures without any opportunity for learners' individual knowledge construction or merely offer resources without any guidance for the learners. Courses for distance education should use well balanced aspects of construction and instruction to provide benefits for the learners. The instructional design of courses may be featured by several methods which apply information technology. Collaboration-specific methods structure collaboration tools to optimize collaborative learning processes. Content-specific methods use tools to facilitate learners' collaborative knowledge construction on a conceptual level. Both can enhance the instructional design and the outcomes of distance education courses.

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## REFERENCES

Baker, M., & Lund, K. (1997). Promoting reflective interactions in a CSCL environment. *Journal of Computer Assisted Learning, 13*(3), 175-193.

Bernard, R. M., Abrami, P. C., Lou, Y., Borokhovski, E., Wade, A., Wozney, L., Wallet, P. A., Fiset, M., & Huang, B. (2004). How does distance education compare with classroom instruction? A meta-analysis of the empirical literature. *Review of Educational Research, 74*(3), 379-439.

Brooks, L. W., & Dansereau, D. F. (1983). Effects of structural schema training and text organization on expository prose processing. *Journal of Educational Psychology, 75*(6), 811-820.

Clark, R. E. (1994). Media will never influence learning. *Educational Technology Research and Development, 42*(2), 21-29.

Cognition and Technology Group at Vanderbilt. (1997). *The Jasper Project: Lessons in curriculum, instruction, assessment, and professional development*. Mahwah, NJ: Erlbaum.

Dansereau, D. F., Collins, K. W., McDonald, B. A., Holley, C. D., Garland, J. C., Diekhoff, G., et al. (1979). Development and evaluation of a learning strategy training program. *Journal of Educational Psychology, 71*(1), 64-73.

Dillenbourg, P., & Traum, D. (2006). Sharing solutions: persistence and grounding in multimodal collaborative problem solving. *Journal of the Learning Sciences, 15*(1), 121-151.

Dobson, M. (1999). Information enforcement and learning with interactive graphical systems. *Learning and Instruction, 9*(4), 365-390.

Ertl, B., Fischer, F., & Mandl, H. (2006). Conceptual and socio-cognitive support for collaborative learning in videoconferencing environments. *Computers & Education, 47*(3), 298-315

Ertl, B., Reiserer, M., & Mandl, H. (2005). Fostering collaborative learning in videoconferencing: the influence of content schemes and collaboration scripts on collaboration outcomes and individual learning outcomes. *Education, Communication & Information, 5*(2), 147-166.

Ertl, B., Winkler, K., & Mandl, H. (2007). E-learning: Trends and future development. In F. M. M. Neto, & F. V. Brasileiro (Eds.), *Advances in computer-supported learning* (pp. 122-144). Hershey, PA: Information Science Publishing.

Fischer, F., Bruhn, J., Gräsel, C., & Mandl, H. (2000). Kooperatives Lernen mit Videokonferenzen: Gemeinsame Wissenskonstruktion und individueller Lernerfolg [Cooperative learning in videoconferencing. Collaborative knowledge construction and individual learning outcomes]. *Kognitionswissenschaft, 9*, 5-16.

Fischer, F., Bruhn, J., Gräsel, C., & Mandl, H. (2002). Fostering collaborative knowledge construction with visualization tools. *Learning and Instruction, 12*, 213-232.

Haben, M. (2002). E-Learning in large German companies: Most of the concepts are not effective. *Computerwoche, 30*(22), 12-16.

Hiltz, S. R. (1997). Impacts of college-level courses via asynchronous learning networks: Some preliminary results. *Journal of Asynchronous Learning Networks, 1*(2), 1-19.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*(2), 75-86.

Kolodner, J. L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., et al. (2003). Problem-based learning meets case-based reasoning in the middle-school science classroom: Putting learning by Design™ into practice. *The Journal of the Learning Sciences, 12*(4), 495-547.

Larkin, J. H., & Simon, H. A. (1987). Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science, 11*, 65-99.

Lehtinen, E. (2003). Computer-supported collaborative learning: An approach to powerful learning environments. In E. De Corte, L. Verschaffel, N. Entwistle, & J. J. G. v. Merrienboer (Eds.), *Powerful learning environments: Unravelling basic components and dimensions* (pp. 35-53). Amsterdam: Elsevier.

Löhner, S., & van Joolingen, W. (2001). Representations for model construction in collaborative inquiry environments. In P. Dillenbourg, A. Eurelings, & K. Hakkarainen (Eds.), *Proceedings of the First European Conference on Computer-Supported Collaborative Learning (euroCSCL)* (pp. 577-584). Maastricht: McLuhan Institute.

Mandl, H., Ertl, B., & Kopp, B. (2006). Computer support for collaborative learning environments. In L. Verschaffel, F. Dochy, M. Boekaerts, & S. Vosniadou (Eds.), *Instructional psychology: Past, present and future trends. Sixteen essays in honor of Erik De Corte* (pp. 223-237). Amsterdam: Elsevier.

Mandl, H., Gräsel, C., & Fischer, F. (1998). Facilitating problem-orientated learning: The role of strategy modeling by experts. In W. Perring, & A. Grob (Eds.), *Control of human behavior, mental processes and awareness. Essays in honor of the 60th birthday of August Flammer* (pp. 165-182). Mahwah, NY: Erlbaum.

Mayer, R. E., Hegarty, M., & Mayer, S. (2005, April). *Does animation improve learning?* Paper presented at the 86th Conference of the American Educational Research Association (AERA), Montréal.

O'Donnell, A. M., & Dansereau, D. F. (1992). Scripted cooperation in student dyads: A method for analyzing and enhancing academic learning and performance. In R. Hertz-Lazarowitz, & N. Miller (Eds.), *Interactions in cooperative groups. The theoretical anatomy of group learning* (pp. 120-141). New York, NY: Cambridge University Press.

O'Donnell, A. M., & King, A. (Eds.). (1999). *Cognitive perspectives on peer learning*. Mahwah, NJ: Erlbaum.

Reinmann-Rothmeier, G., & Mandl, H. (2001). Unterrichten und Lernumgebungen gestalten [Teaching and the instructional design of learning environments]. In A. Krapp, & B. Weidenmann (Eds.), *Pädagogische Psychologie* (pp. 601-646). Weinheim: Beltz.

Roschelle, J., & Teasley, S. D. (1995). The construction of shared knowledge in collaborative problem solving. In C. O'Malley (Ed.), *Computer supported collaborative learning* (pp. 69-97). Berlin: Springer.

Rummel, N., & Spada, H. (2005). Learning to collaborate: An instructional approach to promoting collaborative problem solving in computer-mediated settings. *The Journal of the Learning Sciences, 14*(2), 201-241.

Salomon, G. (1984). Television is "easy" and print is "tough": The differential investment of mental effort in learning as a function of perceptions and attributions. *Journal of Educational Psychology, 76*(4), 647-658.

Salomon, G., & Globerson, T. (1989). When teams do not function the way they ought to. *International Journal of Educational Research, 13*(1), 89-99.

Schweizer, K., Pächter, M., & Weidenmann, B. (2001). A field study on distance education and communication: Experiences of a virtual tutor. *Journal of Computer Mediated Communication, 6*(2).

Shapiro, A. M. (2004). How including prior knowledge as a subject variable may change outcomes of learning research. *American Educational Research Journal, 41*(1), 159-189.

Storck, J., & Sproull, L. (1995). Through a glass darkly: What do people learn in videoconferences? *Human Communication Research, 22*(2), 197-219.

Suthers, D. D., & Hundhausen, C. D. (2003). An experimental study of the effects of representational guidance on collaborative learning processes. *The Journal of the Learning Sciences, 12*(2), 183-218.

Sweller, J., van Merrienboër, J. J. G., & Paas, F. G. W. C. (1998). Cognitive architecture and instructional design. *Educational Psychology Review, 10*(3), 251-296.

Weinberger, A. (2003). *Scripts for computer-supported collaborative learning. [Dissertation, Ludwig-Maximilian-University Munich]*. Retrieved from http://edoc.ub.uni-muenchen.de/archive/00001120/01/Weinberger_Armin.pdf

Weinberger, A., Ertl, B., Fischer, F., & Mandl, H. (2005). Epistemic and social scripts in computer-supported collaborative learning. *Instructional Science, 33*(1), 1-30.

Zhang, J., & Norman, D. A. (1994). Representations in distributed cognitive tasks. *Cognitive Science, 18*(1), 87-122.

## KEY TERMS

**Collaboration:** Tightly working together with a strong commitment of collaboration partners.

**Collaborative Knowledge Construction:** Learners' joint activities to acquire or create new knowledge.

**Content Scheme:** Tabular representation of domain-specific structure to facilitate learners.

**Instructional Design:** The didactical rationale for a learning scenario which includes instructional elements as well as the application of tools.

**Knowledge Construction:** Learners' work with their knowledge in a way that they link their new knowledge to their existing knowledge base in stead of memorizing facts.

**Learning Environment:** Learners' context in distance education courses that is comprised of instructional, social, and technical aspects.

**Powerful Learning Environment:** A learning environment which includes instructional elements that evoke learners' active construction of knowledge.

**Script:** Specification of learning processes which contains procedural aspects, the assignment of roles, and the evocation of beneficial cognitive activities.