Chapter 9
How to Design Support for Collaborative E-Learning:
A Framework of Relevant Dimensions

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ABSTRACT
Research on collaborative e-learning has often shown the effectiveness of students' interaction on their group performance and their individual learning outcomes. However, these positive effects cannot always be found. Collaboration assistance such as pre-collaboration training and collaboration scripts have been shown to support student interaction and problem-solving. When developing assistance for collaboration, teachers and designers must make decisions concerning the processes the support should target, the timing of support, and the interplay of support on multiple levels. The framework we introduce in this book chapter describes these dimensions in detail. We present advantages and disadvantages of different design options, and give an example from our own research to exemplify the design of an e-learning environment that provides collaboration support. We discuss how the circumstances of any particular learning situation might influence which type of support is optimal, and conclude the book chapter with a discussion of possible future developments.

INTRODUCTION
Picture the following scenario: In a science class, groups of three students are asked to research advantages and disadvantages of different options for energy supply for a little village in the Swiss Alps. Using the internet, they collect information on the geographical site, on costs for the different options (e.g. solar panels, windmills, and power plants), and on expected energy outcome. They are instructed to exchange their findings on a wiki page and develop recommendations for the village that they are supposed to present during classroom instruction. The goals of the exercise are to increase student knowledge on prerequisites for, and advantages and disadvantages of, environmentally friendly energy systems. In group 1, Lynn, Marc and Tom are collaborating. Lynn is not very moti-
vated to participate in the group work and hardly contributes to the wiki page. When Marc realizes that Lynn takes advantage of her partners’ efforts, he as well decides to cease his efforts. In the end, Tom mainly works on the wiki page on his own. While he increases his knowledge on the subject, his partners do not show any learning gains.

In another group, the three students Sandy, Bob and Mike are actively engaged in the team work. They split the task between themselves, each student being responsible for a different type of energy supply. Sandy is responsible for finding out information on energy gained from windmills. She is very enthusiastic about this technology and thus encourages her partners to choose this option. However, in her search, she ignores facts about the geographical site of the village and thus does not realize that the site is too calm for windmills to be efficient. Bob mistakenly believes that solar energy cannot be used during night time and thus encourages his partners not to take this option. After several rounds of discussion, the group agrees on advising the village to build windmills. Due to the missing information on Sandy’s part and the erroneous knowledge of Bob, the group has reached a less-than-optimal decision. Additionally, Sandy and Mike might have even adopted erroneous knowledge from Bob during their interaction.

**Promises and Challenges of Collaborative Knowledge-Construction**

Both in school settings and in adult education, there is a trend towards employing collaborative e-learning. There are a variety of different e-learning environments ranging from computer-supported face-to-face interaction, chat, and videoconferencing to asynchronous environments such as wiki pages or knowledge forums. As research on collaborative learning in general, and on collaborative e-learning in particular, has shown, student interaction often positively influences the group performance and the individual learning outcomes (e.g. Lou, Abrami, & d’Appolonia, 2001). The largest effects can be found when comparing individual and collaborative learning for dyadic and small group settings (three to four students, cf. Lou et al., 1996). Positive effects of collaboration have been found in a variety of domains, including reading (Hythecker, Dansereau, & Rocklin, 1988), mathematics (Hooper, 1992), and science (Ploetzner, Fehse, Kneser, & Spada, 1999). The positive impact of interaction on student learning is generally ascribed to an increased processing of the learning content through collaborative activities, such as mutual elaboration, and asking for and giving help (Hausmann, Chi & Roy, 2004; Webb, Troper, & Fall, 1995). However, it has also grown apparent that students often do not exhibit beneficial collaborative behaviors spontaneously. The scenarios presented in the introduction point at several challenges students might encounter in a collaborative e-learning scenario and demonstrate the necessity to support student collaboration in order to yield positive learning outcomes. Two main reasons for students failing to benefit from the learning opportunities of a collaborative e-learning scenario can be identified: challenges of collaborative problem-solving, that is, challenges related to student interaction; and challenges related to the learning domain and the specific learning content. As research has shown, students often do not benefit from collaboration due to unequal engagement in the collaborative learning activity: While a few students in the group take responsibility for the problem-solving, the other students engage in social loafing or free-riding and are not motivated to interact with their partners (Kerr, 1983; O’Donnell, 1999). Unequal participation can particularly be found in larger groups and has detrimental effects on student learning. But even if students are equally engaged in the interaction, they might not show the types of collaborative behaviors that are positively related to learning. Particularly, they often do not engage in sufficient elaboration, which is one of the learning mecha-
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