Chapter 4
Collaborative Knowledge Construction: Examples of Distributed Cognitive Processing

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ABSTRACT
In discussions centered on jointly solving a problem or case, significant construction of new knowledge can occur. Several theoretical frameworks have been invoked to explain the productivity of dialogues, but questions about the relative or unique impact on learning of the multiple facets of dialogues remain. We present an analytical approach that studies small-group discussions from the perspective of joint cognitive processing of knowledge and information. We illustrate our approach through a microanalysis of two discussions that were held in a real-world educational setting. We show that knowledge construction can overlap significantly with critical argumentation, but may occur even in its absence. On the basis of these findings we propose a refined definition of co-construction, and a view of the inter-relations between interaction and co-construction. We discuss the implications of our findings for the analysis and evaluation of differences in knowledge co-construction in different environments.

INTRODUCTION
In discussions centered on jointly solving a problem or carrying out a task, significant construction of new knowledge can occur. Each problem represents a new challenge for a team and requires the use and adaptation of existing knowledge. The productivity and creativity of groups involved in joint problem solving is well known, although the processes by which groups jointly construct knowledge have only recently been studied in detail. Beyond the relevance of research studying these processes for social learning theories, more direct interest in this research is in its potential output for the evaluation of computer systems supporting virtual learning groups. In the last decade, substantial research has addressed issues such as how to support distributed
groups, how to analyse distributed group processes and how distributed processing of knowledge relates to learning gains. This chapter contributes to this literature by presenting an analytical approach by which the joint knowledge construction processes as well as the potential learning gains from such processes are described and modeled. We rely on a microanalysis of dialogues that focuses on relations between learners’ utterances in terms of how they contribute to the processing of an abstract item – such as an idea, concept or example – identifying in this way joint distributed processing of knowledge. This focus on processes rather than media-specific properties of communication renders the approach applicable to group learning and work situations mediated by computer technology.

The identification of these processes relies on an information-processing model of learning from problems, cases and examples that we compiled from the relevant cognitive science literature (the model is described in the section after next). The model allows us to analyze contributions in terms of what knowledge they introduce into the groups’ cognitive environment and how they affect a change in the groups’ conception, interpretation and solution of the problem. This analysis of the ideas and knowledge conveyed in contributions is combined with an analysis of the interactional processes (e.g. argumentation) of exchanges. By carrying out these parallel analyses we are able to describe not only how students interact, but also what effect interactions have on how knowledge is processed and what new knowledge is constructed. We illustrate our analyses with data collected in a real-world educational setting where groups of 1st year medical students discuss cases of professional medical ethics concerning ‘the right to die’. Through this analysis we will show that a generic model capturing distributed cognitive processing can describe in detail knowledge co-construction, and that such a model can support the practical empirical analysis of dialogues. We then discuss the implications of our approach to analyse and evaluate co-construction in face-to-face and computer-mediated communication settings.

BACKGROUND

The theoretical and analytical approach we lay out and illustrate in this chapter is to be seen within the question of how new knowledge is constructed in and from social interaction and more generally, how the social and the cognitive interact. These questions have acquired greater relevance as the significance of social interaction in learning has been recognized in research on learning (e.g. Andriessen, Baker & Suthers, 2003). The consensus emerging in recent years assumes the pre-eminence of the social in conversation and collaboration while also accepting that knowledge is transformed through the social (cf. D’Andrade, 1981, Hutchins, 1995; Stahl, 2003). For example, we will show in this chapter that learners’ utterances contribute to interpretation construction while they engage in an argumentation.

As a result of the dual nature of interaction, research often separates analytically the social from the knowledge-transformational. For example, while an interaction follows socially accepted conventions, contributions to an argumentation also convey and transform knowledge, and affect how a problem is recognized as such, problematised, interpreted and solved (Barron, 2003). While this analytical separation does not question the primacy of the social, contributions to a conversation carrying content and transforming knowledge affect a groups’ problem conception. Suthers (Suthers et al., 2005), for example, recognizes the primacy of the social but also analyses semantic-informational relations between utterances once there is evidence for social interaction to trace the development of shared conceptions. Our analysis lies on a similar research agenda, but by studying the processing of information and knowledge in terms of their distribution over people and in terms of what knowledge they construct, we extend the