Supporting the development of a working relation in a synchronous electronic collaborative writing environment

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Introduction

In this contribution, we report on the design of an experiment in which we examine the development of interpersonal communication during electronic collaborative writing. The work is based on earlier research findings (Veerman, 2000; Andriessen, Erkens, Peters, van de Laak & Coirier, in press) with university students. In that research we could distinguish pairs of students that focused on the meaning of conceptual information, trying to engage in epistemic discussions, and pairs of students whose main goal was to deliver a result, such as the solution to the problem, or a common text. While the first type of collaborators more closely behaved according to the goal of the task set by the experimenters, they also appeared more sensitive to characteristics of the CSCL environment they were using. As a consequence, the focus of their discussions also involved many problems that hindered meaningful discussion, such as technical matters, planning the task, and issues concerning the synchronization of the discussion. The purpose of this experiment is to investigate the effect of working with interfaces that aim at supporting (1) students in developing a better working relationship, in terms of regulation of social, task-oriented, and conceptual common ground; and (2) students in becoming more engaged in epistemic activities. The experiment is part of a project in which the regulation and coordination of interaction during several collaborative learning tasks is studied.

Background

Developing a shared understanding of concepts is an important process in collaborative learning, but it seems that realizing this type of interaction (involving negotiation about the meaning of concepts) is especially difficult to in computer-mediated communication (Veerman, 2000). Veermans' analysis of focus and focus-shifts indicates that some characteristics of the synchronous chat-interface may hinder the coordination and regulation needed to develop a shared understanding.

In trying to make sense of how the interface exerts, or is able to exert, its influence on computer-mediated interaction, we investigate how the working-relationship between collaborative pairs evolves during a collaborative writing task. We hypothesize that better support of the social and task oriented aspects of collaboration, by offering appropriate sentence-openers at the interface, will foster the development of better communication, which in turn will foster negotiation and co-construction of knowledge.

The hypothesis is derived from Veermans (2000) comparison of collaborators who pursued meaning-making activities versus the majority of collaborators who focused on the use of concepts. The latter were better able to reach their goals. Two problems are observable, a) most collaborators do not pursue meaning making activities and b) when pursuing this strategy collaborators run into problems. The tasks involved using CMC for open-problem solving, and defending decisions in the context of designing an educational computer program.

An interaction thus seems to exist between the way students perceive a task (focus on task completion and the use of concepts versus focus on concept meaning) and their ability to handle the task in a CMC-setting. A possible explanation for this phenomenon is offered by grounding theory. According to the grounding criterion of Clark and Schaefer (1987) *"speaker and addressees mutually believe that the addressees have understood what the speaker meant to a criterion sufficient for current purposes"*.

This would mean that the meaning-making dyads in Veermans' research set their goals higher regarding mutual understanding compared to dyads focusing on the use of concepts. It is from here a next step to suppose that the higher goal (according to the grounding criterion) of meaning-making asks for a better working relation between participants, a high-level working relationship that might be difficult to develop and maintain through computer mediated interaction, leading to not pursuing this type of interaction, and difficulties in maintaining such interaction.

Negotiation in collaborative writing

Composing and discussing information during composing of an argumentative text requires collaborators to form an opinion to defend, to evaluate arguments pro and contra, and to assess information to its' relevance in the local and global text-context. In text composition, several subtasks, like idea-generation and revision, combine to result in a coherent and deep understanding of the subject. The role of a partner with whom one works synchronously on the same text is not unambiguous, he or she can be facilitating but also inhibiting. Research into brainstorming, for example, shows that groups do not always perform better than individuals do, showing the importance of the framework in which such a task is performed.

Research by Andriessen et al. (in press) discusses the process of *knowledge negotiation* in collaborative writing, which they describe as discussion for agreement about concepts and their interpretation in the context of a learning task. Negotiation may be about problem solutions, meanings of concepts, and other things. Argumentation is one of the forms that dialogues in negotiation may take (Baker, 1994; Dillenbourg and Baker, 1996). The extent to which negotiation fosters individual learning depends on specific meaningful exchanges between individual participants. The analysis showed that university students that collaboratively produce an argumentative text through CMC do not tend to negotiate each item of content extensively. When they do, as in elaborate argumentation, this immediately increases the variety of arguments in the discussion, in terms of their orientation, pro- and counter the main position of the text. Also, information discussed as elaborate argumentation is immediately entered into the text under construction. However, in most of the discussion, participants are quite willing to accept most content put forward by the other.

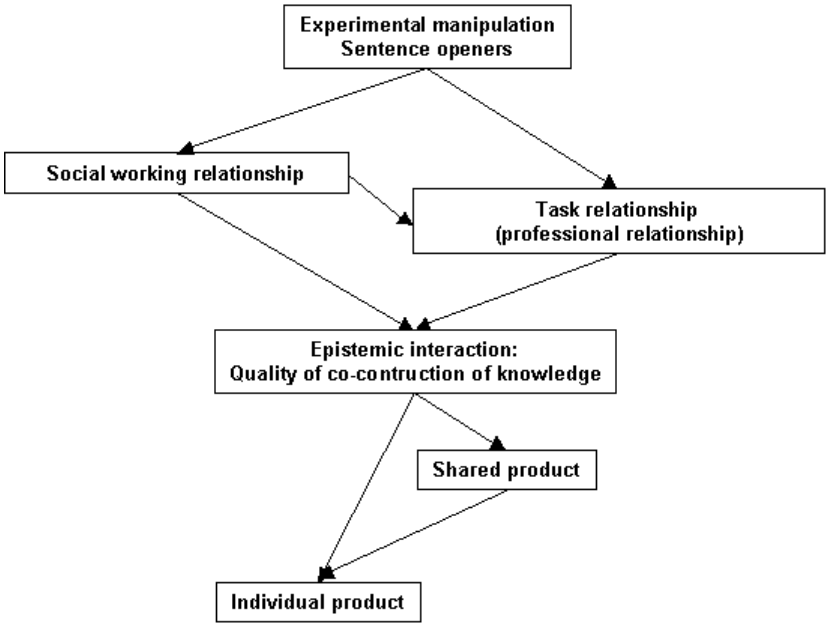
Of course, from a learning perspective, such an attitude is undesirable, and has to be overcome by redesigning the educational context of such tasks (Andriessen, Baker & Suthers, in press). Our aim is more modest here, as we try to investigate whether, within the constraints of a school environment, redesigning the interface could affect this minimal behavior. For example, Jermann & Dillenbourg (in press) show that when the computer tool (by its design) orients the students towards expressing differences in opinion, students abandon their usual 'standing pat' attitude (Baker, 1994). Certain tool features served to perceive the task in a different way, which worked out in the context of the educational scenario designed by Jermann & Dillenbourg.

Establishing a working relationship through chat

Working together on an argumentative text requires more than just interaction about content, probably as important is the interaction that communicates, direct or indirect, how the 'together' is shaped. This is not only of interest to the researcher (with a birds eye view), also the participant relies on this shaping of a social collaborative context for how to proceed. As proposed before, chat/CMC as an interaction medium could possibly be interfering this process, resulting in below-standard conceptual interaction. Compared to 'natural' face-to-face interaction, chat lacks all non-textual cues. Generally perceived positive effects of chat are:

- An equalizing effect (concerning interpersonal interaction): participants are more free to express themselves, feel more anonymous, possibilities of exercising power are limited.
- An effect of having to be more explicit in communicating meaning an intentions

As a negative counterbalance, it is more difficult to build an interpersonal relationship via chat. Trust, responsibility for the other and for the collaborative work are built much easier in a face-to-face situation. Chat, for several possible reasons, causes difficulties for the coordination and regulation of learning interaction:



- On a linguistic level, collaborators might have to adapt their way of interaction to the medium, the written communication medium might for example invite focus changes from topic to topic easier, because of lack of cues available in f2f-situations.
- The cost of subsequent repair, a form of grounding (the correct and sufficient understanding of each other), is high compared to face-to-face interaction. This and other interaction-mechanisms might not be utilized as much as is necessary.
- This could then disturb the working relationship on an interpersonal level.

The above illustrates how on different levels (linguistics, interaction and interpersonal), reasons can be found for the failure to establish a positive working relationship. An option to overcome these kind of problems is to support chat-communication. We have chosen to use sentence openers for they can help maintain focus and they can lower the social cost of making a repair (or the initiating costs). In the experiment two sets of sentence openers are tested; one set focuses on the 'we' aspect, the other on the 'relevance to the task'. Simple comments like 'good idea' or 'good plan' are an easy way to stimulate the partner and maintain a positive atmosphere, and a 'grmbl' is an easy way to show annoyance, that otherwise might indirectly show via cynical remarks, that are difficult to 'read' via chat. Sentence openers can lower borders (socially and initiating) for showing uncertainty, for example "what do you mean by…" or "I do not understand…" prompts for sharing information and thoughts, while at the same time focusing on a specific topic.

The experiment

The focus of this research is on how the environment enables interaction between collaborators and how it enables handling and presentation of information/knowledge. Here we use a synchronous writing tool for collaborative dyads, using chat for communication and a shared text editor for writing/information presentation/handling. Subjects are 152 high-school students (15-17 years old), being immersed in a studio scenario, characterized by frequent collaborative and project-based assignments. Topics are negotiated with the teacher and the task is part of regular classroom assignments, to be used and rated by the teacher. In the design, (1) individual background knowledge on a topic is offered as a starting point for the (2) individual construction of diagrammatic representations. Then, (3) pairs of students are formed on the basis of the similar degree of elaboration of their individual diagrams. Subsequently, (4) these pairs of students are confronted with each others' representations and are asked to collaborate on the production of an argumentative text, with the comparison of the diagrams as a starting point. After the collaborative session, (5) students are asked to revise their diagrams according to the changes in their personal viewpoints on the basis of the

discussion. Students are informed the goal of the task is to further develop and refine their knowledge of the topic.

Collaboration is further supported at the level of the interface through sentence openers focusing on social and task oriented aspects of handling information. We aim to focus attention to these aspects of collaboration, ultimately aiming at elaborate negotiation about the meanings of concepts. The analysis focuses on the relationship between social, task- and content-related interaction by use of sentence openers (see below).

Analysis

In order to reach insight in how the experimental manipulation -the use of sentence openers- influences collaborative interaction, the goal of the analysis is to link the developing social relationship and task relationship to the quality and success of content development as a measurement of collaborative interaction. Initially episodes will be distinguished (by topic change) that are social, task-related or epistemic in nature. Social and task relationship (together: the working relationship) are viewed as characterizations of episodes. An analysis scheme has to be developed to qualify episodes on how they contribute to a positive social environment and a clear grasp and organization of the task. 'Sharing personal information', 'gossip' and 'commenting on each other', are categories perceivable in the development of social relationship, while 'discussing/agreeing on goals and task perception' and 'making deals about division of work/roles', can point toward the development of a task-orientation.

Success of content development, the effectiveness in relation to delivered products, is measured individually, using the changes in the initial diagrams the students made after the collaborative writing task. The changes in diagrams thus provide a measurement of perceived important changes in their knowledge representation. By comparing these changes between collaborators, we expect to be able to classify the outcomes of the collaborative process as:

- Mutually convergent: both diagrams change equally and become more similar, indicating an equal collaborative process of co-construction
- Single sided convergent: one diagram changes more than the other, becoming more similar, indicating a non-equal process of explaining, rather than co-construction.
- Divergent: diagrams grow dissimilar, indicating problems in the collaborative process like unresolved disagreement or problems in developing a shared understanding.

On the group level, the developed content of the collaboratively produced text is another measure of success in collaborative content development.

The quality of content development in interaction (through chat and the use of the text editor) will be assessed in relation to the collaborativeness of that development. For content/epistemic interaction episodes the (collaborative) nature of developing knowledge co-construction will be scored, categorized as follows:

1. Adding information (without interaction)
2. Explaining (transmission of information)
3. Building shared knowledge (collaborative knowledge construction)
    a. Triggering (non-content related social stimulation)
    b. Grounding (for example, rephrasing or repeating)
    c. Building on each other (content related elaboration/argumentation)

This categorization then (where 3c represents the collaborative end of the scale) can be related to the changes in diagrams and the appearance of content in the text, showing if the collaborativeness of epistemic interaction leaves an impression on individual knowledge and the 'group' knowledge respectively.

After this global analysis of the session, a more detailed analysis will take place, zooming in on the epistemic episodes. Within these episodes, for each contribution social and task aspects as well as epistemic aspects of each contribution are analyzed to see how on a local level, the buildup of a working relationship shapes successful and qualitatively good knowledge-construction.

Effects of the interface manipulation will be tested against differences between student-pairs' changes in diagrammatic representation, on the classification of epistemic interaction episodes, and on scores of (local and global) social and task related interaction, every step coming closer to what we directly

try to manipulate. The effect will be tested for a) availability of sentence openers (experimental conditions) and b) counts of the actual use of sentence openers.
What is still neglected in this analysis is an explicit account of the writing process, and how this influences collaboration. This factor will be part of future analysis, making clear if and how collaborative learning interaction is affected by the specific context of collaborative writing.

A modeling proposal: from transmission to studio

Establishment of a better working relationship between participants in a collaborative task is indirectly affected by the educational context, through the participants' perception of the task. Also, from the modeling perspective, desired user support is derived from the didactical scenario that a user is working in. The proposition that we briefly like to develop here is that the didactical question is primary for deciding about modeling issues. Desired user support defines the knowledge a system needs in order to model a user and user progress. In our case, users can be characterized as being involved in a gradual shift from learning as knowledge transmission to a studio scenario (Andriessen & Sandberg, 1999; Andriessen, Baker & Suthers, in press).
In transmission, the goal of education is the development of personal understanding of expert knowledge. In transmission, collaboration is mainly considered as a reasoning or problem solving process, in which learners try to articulate strong and relevant arguments to arrive at approved conclusions or solutions. The situational constraint that drives the argumentation in the first place is the teacher, or in a more abstract sense, the domain expert, not the interests or personal goals of the participants themselves. Hence, what is being confronted during collaboration between two students concerns not only their personal representations, but also those of experts, represented in the teacher's words or the textbook contents. In other words, for the participants the issue at stake during argumentation in knowledge transmission is: is this information *correct*? Ideally, this would require on-line expert feedback and prompting, originally one of the main goals of Intelligent Tutoring Systems (Andriessen & Sandberg, 1999). Collaboration in transmission does not work effectively because transmission focuses on individual knowledge and the correctness of that knowledge.
The second educational scenario distinguished by Andriessen and Sandberg (1999) was called *studio*. Instead of focusing on personal understanding of normative information as in transmission, the studio scenario concerns the acquisition of self-regulated learning skills. The learning environment is seen as a collection of tools and tasks to be used by learners to adapt their learning to their needs and goals. Collaborative learning is one of the skills that learners are supposed to master. Instead of collaboration being acquired as a by-product of knowledge acquisition, now it is addressed in a number of different tasks in which different functions of collaboration and roles of participants are the focus of attention. While studio scenarios presuppose that learners have the ability to understand given information, the new focus is now on their individual roles as learners and collaborators that have to apply and extend their understanding to different tasks. Typically, the tasks are open, with no fixed solutions or solution paths, and allow adaptation to specific individual knowledge and skills. In studio, learners are learning to arrive at *shared understanding*, by dialogue and communication of information and knowledge through the use of various tools available in the environment. This involves, among other things, discussing different viewpoints, and integrating personal beliefs, other peoples' ideas and information from different sources in a process of argumentative learning (Stahl, 2000). In studio, the context is ripe for the development and use of CSCL environments that (1) adequately *support* (as opposed to enable) collaborative (and argumentative) learning, (2) allow using *generic tools* that are not task- and domain-specific as in transmission, and (3) do not treat collaboration as a single type of activity, but instead allow attention for *development* of users, differentiation of user *roles* and distinction of different *phases* in task-based discussions.). The focus of support in studio is on the *pragmatics* of collaborative argumentation (when, why, and how to argue, and for what purpose?) with the aim of (1) reducing the space of misunderstanding during collaborative learning (Dillenbourg, 2000), (2) increasing metacognitive awareness of learning, collaboration and the role of argumentation (e.g. Kuhn, Shaw & Felton, 1997), and (3) preparing learners for the practice of group work and knowledge building discourse (e.g. Bereiter, in press).

We suppose that our users are in some transition phase between knowledge transmission and studio. This requires explicit support with respect to the pragmatics of collaborative learning. A system designed to support such learning serves to gradually changing users' representation of collaboration, by focusing on the process of communication, monitoring user roles in terms of ontologies that represent features of dialogue episodes that characterize types of collaboration in a task context or task phase. Monitoring growing awareness of collaboration may be seen as collecting evidence (in user profiles) of richer dialogues (argumentative, epistemic, social, task-related) during task execution. Figure 1 and table 1 may somewhat clarify how we view such a modeling process. Table 1 (below) shows expected/observed behavior of students in the current experiment in the context of the pedagogical-ideological transformation (further explained in figure 1). The current research should provide information about the interrelatedness of working relationship and content development and the effectiveness of 'static feedback' using sentence openers. The table shows we expect no effect of sentence openers when students engage in a transmission scenario. More dynamic feedback, based on computational modeling could, assessing the used model, give more situation dependent feedback, prompting students to engage in or (even better) to develop studio-scenario behavior.

In the perspective of modeling collaboration, we do not think a general model for collaboration is feasible, as collaboration stands for different forms of interaction and communication in many different specific task contexts. A general model would seem to characterize collaboration as a uniform concept, somewhat similar to writing, communicating, or acquisition of metacognitive skills. In contrast, what we propose (for discussion in the workshop) at least for the studio scenario, is the development of task and user *specific collaboration-ontologies* that allow a system to evaluate user-roles and user development in terms of progress in the context of a collaborative learning scenario. This only works in appropriate educational contexts that help to tune user task perception towards desired goals.

Conclusion & Discussion for the workshop (Issue 1)

In this paper we argued that, next to a content related product, collaborators have to build a working relationship too. This working relationship forms the basis for collaborative learning activities and involves general social interaction and a more situation-specific shared task-perception. Hypothesized is that if these components of the working relationship are better developed between collaborative pairs, they will perform better in co-constructive activities and more specific in meaning oriented discussion.

By manipulating the communication interface, by exposing student-pairs with sentence openers that focus either on the social aspect of interaction or on the task aspect of interaction, we hope to stimulate a better working relationship compared to subjects not receiving such stimulus. Dependent on results concerning the effectiveness of the interface manipulation, a next experiment could focus on awareness of different roles in the collaborative process (like maintaining social cohesion, or task management) or in the writing process (idea generation, idea development (argumentation) integration, revision). This would extend the current experiment, where just one aspect of collaboration is stimulated in a more interactive stimulus, where choice of roles and their complementarities should help maintaining focus, both on epistemic aspects of the task and on social and task-related coordination and regulation.

We have four questions for discussion in the workshop. First, the definition of collaborative learning determines how to construct a model about the interaction that constitutes collaborative learning. Here the 'dichotomy' collaboration (synchronous) -cooperation (division of tasks) is an issue, as is role taking or any other division of work. What kind of interaction do we expect to characterize the nature of the collaborative task and setting? Second, the medium used for interaction and its affordances should be taken into account. What type of interaction can one normally expect through a specific medium? Third, the question is what information can be reliably measured and used for model construction; participation is easily to measure, but what does it say about the contribution to the collaborative learning process? What type of model or theory is needed? Finally, but most importantly, the constraints of the setting point at the (didactical) issue of giving feedback: what aspects of the interaction should we be supporting, and what do we leave for students to develop themselves? When,

for example, the computer gives cues about every step in the learning process, will students learn how to plan their work?

Table 1. Identifiers and characteristics for transmission and studio scenarios. The characteristics of 'this experiment' are based on the task design and on observations.

		Transmission (understanding)	Transition phase (this experiment)	**Studio** (+ learning to collaborate)
General		No truly collaborative situation Skills for efficient product realization	Accepting collaborative situation (fight or flight) Utilization of non-standard skills (attempts to conform to collaborative situation)	Commitment to collaborative situation Development & monitoring collaborative skills
Working relation	Social cohesion	Authority (knowledge) driven/determined	Emotional relationship development (within and outside collaborative situation)	Social grounding: humor, accept (social) confrontation, taking shared responsibility, dealing with emotions/resolving conflict
	Task Management	Product orientation	Goal interpretation	Professionalism: role taking strategies, own goal setting, negotiation
Content development		Explaining, check reliability to source referencing, factseeking, confirmation of facts Identification of relevant source material	Questioning & comparison of source authority Identification of interrelated key concepts	True dialogue, prompting, argument development, content generation Development & understanding of key concepts
Modeling…..		Use of concepts	Dialogue fragments appropriate to tr>st transition scenarios	Dialogue fragments characteristic of user roles, based on studio scenarios

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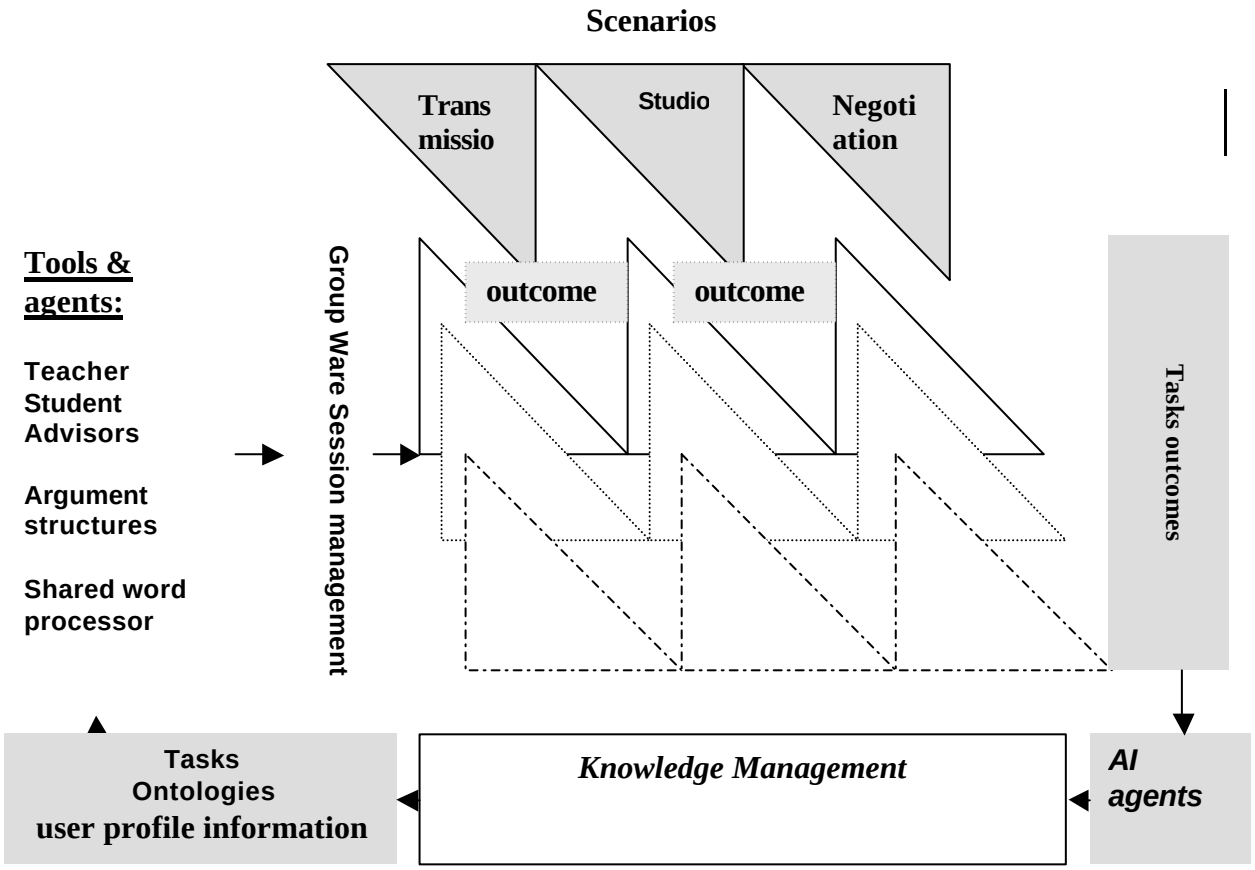
Figure 1



Short description of the figure: Users are engaged in tasks designed according to a specific scenario (transmission, studio, negotiation). Depending on the scenario, different task outcomes are set, and different tools and agents come into play. Also, different roles for domain knowledge management and different task ontologies and user profile information are desired. Most importantly users, that is teachers as well as learners, have different roles to play in each task. All these requirements have to be designed on the basis of extensive user requirements analysis, leading to different functional specifications and tool design for the system. The figure also shows that there is a certain order (evolution) in the design of the tasks: from knowledge transmission to knowledge negotiation.