Towards Supporting
Effective Interaction in E-learning

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Abstract—In this contribution, we describe our preliminary statement towards the long-term goal of creating an intelligent agent for monitoring interaction in the communication environments of the communities of practice. The assumption underlying our research work is that embedding some form of artificial intelligence in these environments enhances effective interaction during collaborative learning and knowledge sharing. We start by providing a description of the theoretical conceptual framework, illustrate the state of the art in the domain and conclude by sketching the guidelines for a method we intend to implement and test in our future work on real data collected through a web forum developed in our previous research.

Index Terms—e-learning, communities of practice, modeling interaction, web forums

I. INTRODUCTION

Interaction plays a fundamental role in the process of building and sharing knowledge. This claim is widely supported by the success of the e-learning paradigm: the advent of the web as a communication media has enabled universities and companies to overcome the limitations due to geographical distances through the development of communities of practice, forum, online collaborative learning environments and so on.

The main limitation in using such devices for improving our own skill and, in general, for education, is the loss of the constructive feedback provided by human tutors in face-to-face teaching. Moreover, the way in which people interact in such a community, may considerably affect the effectiveness of the process of building new knowledge. Embedding some form of intelligent analysis in online learning environment may help in facilitating the cooperative development of the learning process.

The long-term goal of our research is to define a method for monitoring the computer-mediated interaction in e-learning environments, such as web forum or chat of communities of practice. Such a method may constitute the basic behavior of an agent playing the role of an intelligent supervisor in these environments [43,3]. The main activity of an agent of this type is to constantly monitor the activity of the members of the community: by observing the dialog dynamics occurring in each chat conversation or thread in a web forum, it should be able to detect critical situation that represents a deviation from the optimal pattern of an effective interaction aiming at solving knowledge-sharing or collaborative learning task. Interaction between the students and the teacher is not the primary factor for successful learning in the traditional teaching paradigm. On the contrary, the activity of the members of a community of practice is highly interactive: the learners are the main actors of the process aiming at building new knowledge by sharing information or by accomplishing problem solving task in a cooperative way.

Community of practice would surely benefits form the embedding of some form of artificial intelligence in their framework: an intelligent agent, for example, could be implemented to guide the members of the community towards the adoption of behaviors that are considered successful from the effective knowledge sharing point of view. The main assumption underlying our research project is that collaborative e-learning activity may be improved and positively affected by the adoption of the appropriate, effective behavior of people taking part to the discussion.

The paper is structured as follows: in Section II we provide the description of the conceptual framework we refer to in our research; then, in Section III we describe the state of the art on analysis of interaction in collaborative learning environments; in Section IV we sketch the method we intend to implement and test in our future research; finally, we provide conclusions and directions for future work.

II. CONCEPTUAL FRAMEWORK: E-LEARNING AND COLLABORATIVE ACTIVITY: USING WEB FORUM IN THE COMMUNITIES OF PRACTICE

Studies and research experiences in several domains highlight how the knowledge sharing among peers in collaborative online environments are a key approach to the creation and diffusion of new knowledge [28,21,24].

It is the case, in particular, of the communities of practice, an environment that is gaining more and more importance and that is being widely used in recent years. Communities of practice provide a fertile ground for activities, such as group learning processes, which favor,
in their turn, the building and sharing of new knowledge in the scope of a shared repertoire [41,42].

The communities of practice are formed by people sharing common interests and practices, that spontaneously and informally aggregate in order to share their knowledge and to cooperate in the learning process.

The concept of community of practice has been developed in the scope of sociological and anthropological studies based on the assumption that the learning has a strong proactive and interactive component [19,41,42]. This vision overcomes the traditional paradigm of learning in which the teacher provides all the information, knowledge and tools needed to the student, who passively acquires abstract notions proposed by the tutor [11]. In the communities of practice, on the contrary, the learning process is modeled as a social phenomenon: the way the knowledge is managed in the scope of the communities of practice, has the main advantage of enabling the formalization also of the tacit knowledge, which is usually difficult to transfer from one person to another [25].

The main feature of the communities of practice, then, is that they can be seen as ‘learning communities’ [11] in which the communication and the cooperation among the participants as well as the sharing of experiences and the mutual help are the key factor of the success of the learning process and enhance the acquisition and consolidation of professional skills in the members [40].

The learning process is based on the interaction between the members of the community. As a consequence, the role of the web technologies is becoming increasingly important in this scenario since they can enhance and support interaction, even between members who are physically distant. These technologies (e.g. email, forum, videoconference, and so on) offer, in fact, the possibility of overcoming the limitations due to physical and temporal barriers among people, hence favoring the interaction processes that are the key factor for the success of the communities of practice [14,15].

The huge variety of the existing technologies and the specificity and originality of each individual community of practice, though, make difficult to recognize, among all the possible web technologies, the most suitable one for effectively supporting in the best way the learning function of the community of practice.

A fundamental role in this sense is surely played by the web forum: they are easy to use and implement and can be seen as both communication instruments and powerful frameworks for the building and the sharing of knowledge. A web forum, in fact, can be used as a discussion environment and as a platform for collaborative knowledge sharing, learning and problem solving but can be also employed as an informal ‘repository’ through which the cognitive memory of the members of the community can be made ‘persistent’.

In spite of its simplicity, though, the use of a web forum does not necessary ensure that the exchanges among peers are effective in the perspective of achieving the knowledge sharing and/or building task. The web forum, in fact, has not being originally conceived nor designed as an e-learning environment. On the contrary, forum and chats are often seen as devices through which task-free and informal conversations may take place [6].

The difficulties that traditionally are encountered in the classical teaching paradigm ‘in praesentia’ can be encountered as well in such virtual learning environments. Moreover, they could be even bigger if combined to those related to the asynchronous communication that takes part in a web forum.

Also, the technological research in the collaborative learning domain [7] has demonstrated how members of a collaborative learning group do not necessary hold the required social and communication skills to successfully conduct the interaction.

Hence, it becomes important to define a method for the analysis of the interaction on a web forum so as to evaluate on real time the effectiveness of the individual discussions going on in the community with respect to the task of creating and sharing new knowledge. By enriching the communication devices of a community of practice (chats, forum) with some form of embedded intelligence, the system would be able to monitor and guide the people involved in the interaction towards a more effective and fruitful behavior in case of divergence from the ideal pattern of an effective e-learning interaction.

III. ANALYSIS OF THE INTERACTION ON A WEB FORUM

Thanks to technological research in the e-learning domain, several theoretical models have been proposed to enhance effective interaction in online collaborative environment as well as the implementation of intelligent agents or systems to support the online collaborative learning activity [6,17,23]. The main goal of these research projects has been to develop and apply effective conversational models to which the members of a community of practice or, more in general, of a collaborative learning environment may refer during the interaction.

In this scenario, the majority of these models aims at the creation of intelligent systems able to support the interaction, which exploit conversational models designed to enhance reflection on own knowledge, elaboration and explanations of information, ideas and opinions, motivation and articulation of the reasoning through argumentation and negotiation processes, which are the activities that typically characterize the effective collaborative learning among peers [38,5,12,16,33].

These methodologies can be effectively applied to the analysis of the interactions in the e-learning scenario. The
main source of inspiration for our research is the “Collaborative Learning Model” and, in particular, the “Collaborative Learning Conversation Skill Taxonomy” developed by Soller [38] on the basis of the “Collaborative Skills Network” by McManus and Aiken [23].

The Collaborative Learning Conversation Skill Taxonomy, adapted from McManus and Aiken’s one, is based on the identification three main be Skills which define the behavior of people taking part to a collaborative learning activity:

- the Active learning conversation skills, describing the ability of using social skill in the interaction, that is to know when and how to question, inform and motivate others;
- the Conversation skill, which specifies the activity with respect to the task (e.g. shift of topic or tool), the maintenance of group cohesion and of the involvement of others and the acknowledgement, that is the feedback provided to the other peers with respect to their comments (e.g. appreciation) or question (e.g. yes/no answers);
- the Creative Conflict, that is related to the ability of arguing (i.e. reasoning about others’ comments and suggestions) and mediating (i.e. requesting the intervention of an instructor or a mediator):

The individual contributions (e.g. the single dialogue ‘move’ in a chat) to the interaction are hence characterized by their main communicative goal (e.g. requesting, arguing, answering, and so on). Each communicative action identifies a sub-skill, in this taxonomy, and is further specified by a set of attributes which exactly indicate the intended contribute to the discussion (e.g. suppose, conciliate, agree, reject).

In Soller’s study, the interaction in the collaborative environment is guided through the use of a structured interface: people taking part to the conversation may choose, at every step of the interaction, what is the main focus of their contribution by choosing among the attributes, each one is identified by an ‘opener’ (e.g. “if...the” for suppose, “do you know” for information giving, “no” for reject, and so on). Research in fact demonstrates that structured interfaces enhance effective interaction in e-learning and problem solving scenarios [2,18].

Though, the final goal of our research is to embed some form of artificial intelligence in a system we develop in the scope of our previous research, in which unstructured interaction is allowed. In the next Section we sketch the outline of the method we intend apply in our future research, on the corpus we are now collecting through our web forum [14,15].

IV. WHICH APPROACH?

The final goal of this ongoing research is to investigate whether and how a wrong, non-effective attitude of participant to e-learning problem solving tasks can be recognized in order to guide them towards a more effective and successful behaviour. Such a method will constitute the basis of a module that we plan to integrate in our web forum [14,15] to monitor and guide the members towards an effective interaction.

To this aim we plan to combine language analysis (at the individual post level) and dialog pattern classification techniques (Hidden Markov Models, HMM) [8,29]. Rather than adopting an intrusive approach, we plan to develop a module that constantly monitors [13,4] the conversations of the members of a web forum, in order to understand the dialogue dynamics going on among the participants. In particular, we plan to implement a conversational analysis module that is able to classify what kind of activity is going on and whether it deviates from the typical patterns of effective knowledge sharing. That is, the module has to be equipped in order to understand the shallow dialogue dynamics of the discussion, that is who is telling what to whom. This monitoring activity should be conducted continuously, so that the system could have, at every time of the interaction, the exact and updated image of what is going on in the forum.

Such a module could constitute the basic behavior of a software agent, that will constantly monitor the interaction and decide to intervene in the conversation to guide the participants to a more effective behavior in the perspective of actually building new knowledge, sharing the existing one or managing collaborative problem solving tasks, also in order to both prevent (or even to solve) conflicts and favor (or promote) fruitful exchange among peers with similar needs and goals. The envisaged approach for the implementation of such an agent is the BDI (Belief Desire Intention) paradigm [30]. To this extent, the agent needs to know what kind of interaction is going on among members of the forum, that is what is the task of the dialogue (e.g. Information Seeking, Negotiation etc.) and what is the attitude the interlocutors are showing towards each other (e.g., cooperative vs. individualistic in a negotiation scenario or warm vs. cold in a general topic/small talk discussion).

In this perspective, the agent will equipped so as to collect data about interaction in the network and to identify what kind of dialogue are going on among people taking part to each individual thread on the forum.

In particular, the agent will exploit conversational analysis techniques to produce a shallow annotation of the dialogue exchange among the peer agents. The history of the interaction will be updated by creating a log, which
will serve as a basis for conversational analysis aimed at inferring the dialogue task and the interlocutors’ attitude.

A. Outline of the method

The method that we plan to implement can be schematically described as follows:

- preliminary annotation of the interaction according to the paradigm of the communicative acts [35,1,9]: while not constituting any deep understanding of the dialogue, automatic dialogue act labeling is a task that may be relevant for a wide range of applications in both human-computer and human-human interaction and computer mediated communication for completion of e-learning tasks is one of those, as seen in [38]. The automatic recognition of the communicative intention is a task which has been successfully addressed in several recent research and by adopting a wide variety of natural language processing approaches (see, for example the studies described in [26,31,34,39])

- conversational analysis of the dialogue coded in terms of dialogue act, with the goal of verifying whether the attitude of participant to a discussion matches the ideal pattern of effective e-learning interactions. In particular we aim at detecting, in the corpus of our web forum conversation, the skills described by Soller in its Collaborative Learning Conversation Skill Taxonomy [38], which we briefly described in Section II. The corpus will be annotated so as to isolate successful effective episodes of knowledge sharing or problem solving, as a preliminary step towards the definition of an approach for automatically detecting the learners’ correct or wrong attitude.

In particular, our method will employ conversational analysis techniques (such as Hidden Markov Models [8,29]) for dialogue pattern analysis. In our previous research, we have already tested the potential of the HMM formalism in exploiting dialogue pattern differences in user attitude recognition. In particular we tested the possibility of recognizing the differences in the user attitude due to either stable user features (e.g. background in computer science vs. background in humanities and how this affects the user attitude towards an ECA) or the main goal pursued by the user in a given domain (e.g. Information Seeking task vs. Advice Giving attitude) [22,26]. We are planning to employ the same approach in the conversational analysis engine that will be embedded in the behavior of our agent. The work with which this approach has more in common is the analysis of collaborative distance learning dialogues by Soller [37]. This study aims at dynamically recognize when and why students have trouble in learning the new concepts they share with each other. To this purpose, specific turn sequences are identified and extracted manually from dialogue logs, to be classified as ‘knowledge sharing episodes’ or ‘breakdowns’. Aggregates of student’s acts were associated with the five states HMMs learnt from this corpus.

V. CONCLUSIONS

This contribution is a preliminary statement of the direction in which we are moving in our study about modeling the attitude of participants to a collaborative learning dialogue in order to understand whether it is diverging from the typical pattern of an effective interaction.

In particular, in the next future we intend to annotate the interaction logs we are collecting through the use of our web forum in order to both (i) create a dataset of interactions coded as sequences of dialogue act and (ii) isolate typical pattern which can be classified according to Soller’s taxonomy, as described in Section III. The next step will be to apply conversational analysis techniques to the coded interaction in order to verify whether these phenomena can be isolated and detected automatically, starting from spontaneous and unstructured conversations. Once the divergence from an effective interaction pattern is detected, the system may decide to guide the participants towards a more correct behavior and to support the interaction appropriately.

REFERENCES


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