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Towards adaptable interaction analysis tools in CSCL

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Abstract. Interaction analysis has become a basic function in the field of collaborative learning as a means for supporting *evaluation* processes. These processes can benefit from the use of automatic or semi-automatic interaction analysis tools. If these tools considered the different *roles* implied in the analysis processes, this could permit to exploit the results of the analysis in function of who is the user and what is his/her purpose. The experience of awareness systems in CSCW that use roles to decide the type and amount of information that they show suggest that this can be an appropriate approach. However, a review of the concept and classification of roles in the CSCL literature has shown a great diversity of classifications and a lack of common vocabulary to describe roles that also ignore the dynamic aspects of real situations. These aspects demand a new dimension for the classification of roles capturing dynamic aspects, such as the evolution of roles in an activity. Moreover, they demand a common vocabulary for defining and describing roles in learning scenarios. This would allow to automatically adapt the functionalities of interaction analysis tool to the evolving needs of the roles. This paper elaborates two proposals that help to detect the changes of roles produced during the collaborative activity and identify the needs established for these roles.

1. Introduction

Interaction analysis supports different functionalities in Computer Supported Collaborative Learning (CSCL), such as the *evaluation* of collaborative learning processes. Currently, the evaluation of CSCL systems, and of the learning promoted with them is a priority of research in the area. For this purpose, the researchers propose the elaboration of powerful tools and methods for interaction analysis in the study of collaboration [1].

Our group has been working in the evaluation and the analysis of interactions for the last years. A main research effort has been the development of a system for supporting formative evaluation in CSCL settings. In order to meet this aim, we proposed the *Mixed Evaluation Method* [2]. It defines a general approach oriented to support the formative evaluation of participatory aspects of collaborative learning in real classrooms.

This method is partially supported by an interaction analysis tool called *SAMSA* that builds social networks and computes a set of indexes that are shown to the users for its later analysis. Although this tool was designed to be used by teachers and researchers, its use has shown that it might be useful to support self-evaluation by the students [3]. However, these types of users (teachers, researchers, students) have different needs. This has lead us to work on a more general problem, consisting on the study of these users' characteristics and how the interaction analysis tool can be dynamically adaptable to their different needs.

From the experience of awareness systems that use role-based proposals in the CSCW field [4],[5] we can state that the collaboration-support tools would benefit from considering this adaptation to the user, in order to improve the collaborative processes supported by them. A main problem in these systems is the quantity and type of information that they have to display in a moment, as well

as how it is to be shown, depending on the different roles that participants take during collaboration. From this perspective it is possible to think on interaction analysis tools meeting the needs of different types of users, providing them with different functionalities. For example, the data obtained by the teacher in an intermediate evaluation with *SAMSA* could be used to support the students' self-regulation, but it does not seem reasonable to show the same information to the teacher than to a K-12 or to a university student, neither to use the same format for all the cases. This requires considering the needs of teachers and learners (and other potential participants) in every moment.

It is therefore necessary to identify the *roles* that can appear in the collaborative process, and the requirements they pose to interaction analysis. Also, it will be necessary to detect dynamically the changes of roles during the development of the collaborative activity to adapt the functionalities of interaction analysis tools to their evolving needs. We aim at supporting these processes automatically or semi-automatically.

This paper elaborates on these issues, and proposes a *structured description* for roles, and a new *dimensions* for the classification of roles that permits to capture dynamic aspects, such as the evolution of roles in an activity. This results in a two-way relationship between roles and analysis of interactions. First, analysis of interactions helps to identify roles, and then, these roles (i.e., the people representing them) will be supported by interaction analysis functions. According to the general goal presented beforehand, this support will be adapted to the needs of a particular role.

The rest of the paper is structured as follows: The next section presents a brief summary of the different role definitions and classifications found in the literature. Next, section 3 presents our proposal, which includes the new dimensions for the classification of roles based on dynamic aspects, and the structured description of roles in CSCL. The paper concludes presenting the open research questions and an overview of our future research plans related to these topics.

2. A Review of Roles in Learning Systems

A review of the existing proposals related to roles, based on works from the CSCL, e-learning, CSCW, group dynamics and classroom-based research shows a great diversity. There is a lack of common vocabulary to describe roles, multiple definitions and very different classifications of roles, many of them, domain-dependent.

In this review we have detected a rather high consensus with respect to the generic roles (to which we will refer to as actors) that can be identified in a learning scenario, such as the teacher, the student or the designer [9,13,11,12]. On the contrary, the teachers' and students' roles (to which we will refer to as functions) depend very much on the approach and on the context of each work, and that there is no such consensus between the different authors [7,18,16,17].

We have detected different functionalities for the same role. For example, about the Teacher-facilitator role, [7] states that "must create learning situations and improve the motivation of learners", but [10] considers that "they monitor the collaboration activities within a group, detect problems and intervene". But also we have identified different roles with the same functionality (e.g. [16] and [13] describe in the same terms the roles of the teacher-guide and the tutor).

Moreover, in these descriptions, roles are presented as static entities, in the sense that membership to a given role is established early and rarely changed. Nevertheless, potential role membership can vary from moment to moment during the lifetime of a collaborative session. These roles ignore situational dynamics ("the real world"), and they do not provide the flexibility needed in many situations [6]. For example, during the evolution of a certain task, a teacher should be able to shift from the initial teacher-guide function, when students need more help, to the teacher-observer function, when the students have reached some autonomy [21].

These aspects demand a common vocabulary for defining and describing roles in learning scenarios, and a new dimension for the classification of roles capturing dynamic aspects, such as the evolution of roles in an activity. With these elements, it would be possible to define a description of roles able to be managed computationally, and detect the changes of roles produced during the activity. This would allow to automatically adapt the functionalities of interaction analysis tools to the evolving needs of the dynamic roles. We present our proposals regarding this issue in the next section.

3. A new proposal for describing and classifying roles in CSCL systems

We have identified two dimensions that dynamically help to identify the roles established before the beginning of the activity, and to detect the changes of roles produced during the activity.

Regarding *the moment of their appearance* we define **pre-established** and **emergent roles**. *Pre-established roles* are those that are assigned before the beginning of the collaborative activity (e.g. role defined by a type of task). *Emergent roles* are those that are not assigned in advance, but that appear spontaneously during the development of the activity [22].

According to their *variability* we define **static** and **dynamic roles**. *Static roles* are those that remain invariable from the moment of their appearance until the collaborative activity finishes. *Dynamic roles* are those that vary during the development of the collaborative activity (e.g. due to a rotation of roles among the members of a group).

To detect emergent and dynamic roles, it will be necessary to define a set of indicators and the values that identify the transitions between the different roles. These indicators will be a component into the formal description of a role in a common vocabulary. Then, the interaction analysis tool will be able to identify a change of role by means of these indicators, and it will be able to adapt to their new needs, which will be to specify into the formal description of this role.

Then, the problem would consist on making a common framework for defining and describing roles, their functions and needs for a generic context. We have elaborated a proposal of a structured definition and description of roles in CSCL composed by four dimensions that aim to solve the lack of common vocabulary detected to define and characterize roles in learning scenarios. These four dimensions are: actor, function, needs and indicators.

In this context, an **actor** represents a generic role, that is, a human, an agent or any combination of them [9] (i.e., the *teacher* and the *student* roles have been pre-established roles in a traditional classroom [17]).

A **function** is a characterization of an actor. With a function we could specify its activities, duties and responsibilities (i.e., as a *facilitator*, “a teacher perform a minimal pedagogical intervention in order to redirect the group work in a productive direction or monitor which members are left out of the interaction” [10]).

A **need** is a requirement for each pair role-function. These requirements relate to the necessary information (quantity and type) and the functionalities of tools, and they are influenced by diverse parameters related to the context, such as the environment (synchronous or asynchronous), the educational level of the students (University, K-12, etc), the goal pursued with the interaction analysis tool (regulation, formative evaluation) or the specific activity (i.e. collaborative edition).

An **indicator** is a parameter that helps to identify the transitions between the different roles. Each indicator is composed by a name and the values that identify a possible change of role. The values can be different depending of the context. A tool that recognized changes of roles would use the limit values described by the indicators.

This structure allows for a static description of a role, in the sense that it can be established at the beginning of the collaborative activity. In addition, we have included the *indicators* dimension for defining the values that permit to detect transitions between roles. The next step will be to implement this approach for its computational management.

These approaches aim to provide for the adaptation of the functionalities of interaction analysis tools to the changing needs of roles.

4. Conclusions and Future Work

This paper has presented the need of considering roles when designing tools for the analysis of interactions. This will permit to support the analysis of interaction data collected from a learning experience and to exploit them depending on who is the user and what are his needs. This approach is based on existing proposals from awareness systems in CSCW that adapt to the users' profiles.

An initial review of the concept of role in the literature has shown many different definitions and a great diversity of classifications, many of which are domain-dependent and ignore the dynamic aspects of real situations. Due to this diversity, we have proposed a new dimension based on dynamic aspects for classifying roles, such as the evolution of roles in an activity. Moreover, we

have proposed a structured description of roles in a common vocabulary. Then, the interaction analysis tool will be able to identify a change of role, and it will be able to adapt to their new needs, which will be to specify into the structured description of this role. These are previous steps towards building analysis interactions tools capable of adapting their functionalities depending on the needs of roles at a given moment.

We have to go further in the description of the roles that are involved in collaborative learning scenarios, and establish their functional and user-interface needs. These needs will define the type of support that the different roles will need, which must be achieved by the interaction analysis functions. Moreover, it will be necessary to define the set of indicators and the values that identify the transitions between the different roles, and find a formal representation of this information for its computational and automatic management.

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