AWARENESS SUPPORT IN THE AULANET LEARNING ENVIRONMENT

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Abstract

In this paper, the role of awareness in the 3C collaboration model is discussed, detailing how it relates to its main aspects: communication, coordination and cooperation. Then, some awareness elements of the AulaNet learning environment, which was developed based on this collaboration model, are analyzed.

Key Words

Web-based Education (WBE), E-learning, Awareness, Collaboration Model, learning management system

1. Introduction

Awareness is the act of acquiring information through the senses. In a learning management system, support of awareness must be carefully designed. Through awareness, members of the group have information about what is happening and what other people are doing [2]; individuals realize the changes caused in the environment by the action of participants enabling them to direct their actions and predict possible needs [15]; and participants can create a shared understanding and coordinate themselves so that individual efforts add value to the work.

Awareness involves various cognitive aspects related to human skills. While obtaining information is rich and natural in a face-to-face situation, given that the senses can be fully used, in a virtual environment awareness support is less clear since the means for making information available to the sensory organs of human beings are limited. On the other hand, in a digital environment, irrelevant information can be filtered in a way that reduces the dispersion that normally permeates a face-to-face collaboration.

In this paper, awareness is analyzed based on the concepts of the 3C model (Section 2) [6]. Next (Section 3), awareness support in a learning management system is examined. This case study was conducted in the AulaNet

learningware. Some of the AulaNet's awareness elements, which are interface elements used to dispose awareness information, are shown and explained, with some discussion linking to the concepts presented in the theoretical model exposed in Section 2. Finally, Section 4 concludes the paper.

2. Awareness and Collaboration

To collaborate, people should debate ideas (communication), organize themselves (coordination) and operate together in a shared workspace (cooperation). While they communicate, commitments may be generated. These commitments define the tasks that will be necessary to get the job done. These tasks are managed by the group coordination that organizes the group and guarantees that the tasks are accomplished in the correct order, at the correct time and according to the restrictions imposed. The tasks are accomplished through cooperation among the members of the group, which operate together in the shared space. However, while working, the necessities of renegotiating and of making decisions about non-expected situations appear. This demands a new round of communication, which in turn will modify and generate more commitments that will need coordination to reorganize the tasks that are executed during cooperation. This shows the cyclic aspect of the collaboration. The 3C collaboration model that is presented in Figure 1 summarizes this discussion.
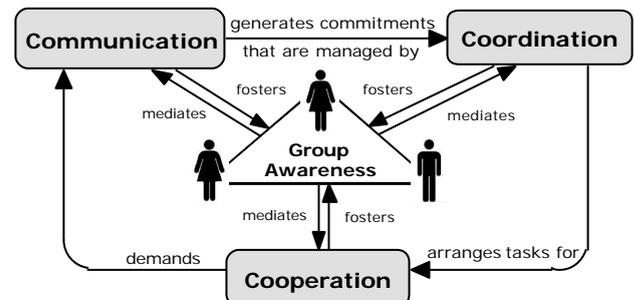

Figure 1 – The 3C Collaboration Model

Awareness occupies a central position in this model. Every event that occurs during communication, coordination and cooperation generates information. Some information should be made available to members of the group. When the information involves two or more members of the group, it is called group awareness information [13]. Through the group awareness information, the information exchanged during communication, the coordination decisions and cooperation objects information are disposed. This helps to build a shared understanding and to synchronize the work.

In the next sections the relations of awareness and communication (Section 2.1), coordination (Section 2.2) and cooperation (Section 2.3) are detailed. Nevertheless, it should be pointed out that despite the separation of these concepts for the purpose of analysis, it is not always possible to consider them in an isolated manner since they are intimately dependent and inter-related.

2.1. Awareness and Communication

Throughout communication, people desire to build common understanding, exchange ideas, discuss, negotiate the meaning of concepts or make decisions [18]. The participants of a work group must communicate to accomplish tasks that are interdependent, not completely described or that require negotiation [7].

Communication is carried out by exchanging messages. Figure 2 models the transmission of messages between two interlocutors. The sender codes the message using the available expression elements, and the communication tool transmits it to the receiver, which has access to it through the awareness elements.
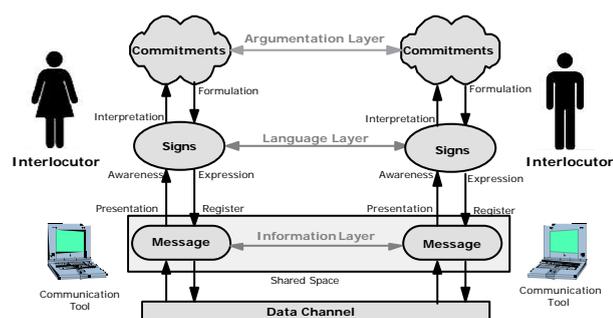

Figure 2 – Modeling the communication

In order to communicate, the sender prepares a message using language that is proper for the conversation, that are defined by the available expression and awareness elements, by the cultural context, by the domain in question and by individual knowledge. The message is formulated in these structures, being comprised of signs, and is transmitted to the receiver, which interprets it in order to recover its meaning.

The content to be transmitted reflects the commitments and the intentions of the sender. The content that is transmitted can result in modifications in the commitments of both interlocutors. It should be remembered that when one communicates, people normally are not aware of the language and of the expression and awareness elements that are used because their attention is directed to the argumentation process. If some type of confusion or problem is detected, the language or elements used are brought into central focus in an attempt to repair the misunderstanding.

Communication is considered to have been successful if there is understanding of the message and if the content that was received is the equivalent to that which was transmitted. The only way of obtaining indications about understanding is through the actions (and reactions) of the receivers, since they are guided by their understandings and commitments. A rupture in the communication, thus, would be discordance between the intentions of the sender and the actions of a receiver upon carrying out the commitments.

So, awareness works as a basis of the communication. If the awareness elements designed to dispose the information transmitted by the messages are not well prepared, a breakdown in the communication will occur.

2.2. Awareness and Coordination

Conversation for action generates commitments [20]. It is necessary to coordinate the activities in order to ensure compliance with these commitments and realization of collaborative work through the sum of individual work.

The group coordinates itself through coordination mechanisms in a manner to ensure the execution of the tasks, respecting the tasks' interdependencies. In some collaborative tools, coordination is carried out by the so-called social protocol, characterized by confidence in the skills of the participants to mediate the interactions and by the absence of explicit coordination mechanisms between the activities. However, some activities require sophisticated coordination mechanisms in order to ensure the success of the collaboration.

With the social protocol or with explicit coordination mechanisms, awareness information is essential for group coordination. It is important that each participant knows about the work progress of each one of his or her colleagues, such as what was done, what needs to be done, what are the preliminary results, etc. The awareness information is particularly necessary during the dynamic coordination phase to transmit changes of plans and to help generate new shared understanding. Without this context, the individuals are not able to measure the quality of their own work compared to the objectives and progress of the group, something that might lead to unnecessary duplication of effort [4].

The awareness elements are particularly useful for carrying out tasks that cannot precisely be defined in advance, where a priori articulation is not sufficient [16]. These ill-defined tasks are particularly common in learning activities, where learners make decisions and try

to solve problems without complete knowledge about the domain [19]. In these kinds of tasks, the division and the organization of work occurs while it is being carried out through the coordination of the activities [9]. The awareness elements help to transmit the changes in plans and to generate new shared understanding. Moreover, they can inform the participants about temporal and spatial aspects of the actions and facilitate the synchronization of the individual tasks.

The group coordinator, if there is one, is normally in more need of this type of awareness information. He or she needs to know, for example, who is or is not working, where there are conflicts of interest and what are the skills and experiences of each one of the participants. Based on this type of information, the coordinator can take the proper actions for coordinating the group [1]. However, the flow of information that goes to the coordinator must be planned very carefully. An excess of information will make decision-making more difficult.

2.3. Awareness and Cooperation

Cooperation is the joint operation in the shared information space, through the interaction of the individuals and the artifacts of the work environment. These interactions, whose objectives in general are to accomplish a task, lead to a series of new happenings that, for their part, will be reflected in the awareness elements where the individuals will seek information for planning and coordinating subsequent interaction. They cooperate by producing, manipulating and organizing information and building and refining cooperation objects, such as documents, spreadsheets, artwork, etc. In order to act upon the objects, the members count upon expression elements; for getting the results of their action (feedback) and the action of their colleagues (feedthrough), they have awareness elements.

Two or more people possess shared understanding of a situation if they have equivalent expectations about it, know what is happening and what is coming next [5]. The shared understanding makes it possible for individuals to build their own work contexts in a manner that lets them work towards the common objective, supplementing the activities of their colleagues.

Individuals seek in awareness elements information necessary to assemble the context and to anticipate the actions and the intentions of their group companions. Furthermore, awareness elements help to identify each participants' role and tasks with relation to the collaborative goals and the cooperation objects [11].

In order to avoid overload, it is necessary to balance the need to supply information with the care to protect the resources destined for work. The supply of information in an asynchronous, structured, filtered and summarized form facilitates this task [12]. A general view of the whole should be supplied and individuals may select which part of the information they desire to work with,

and further details can be obtained when required. Also, there must be some control regarding privacy.

3. The AulaNet Learningware

The AulaNet[1] is a freeware environment based upon a groupware approach for teaching and learning on the Internet. The Software Engineering Laboratory of the Catholic University of Rio de Janeiro (PUC-Rio) has been developing it since June 1997. The AulaNet was designed with the main concepts of the model described in the previous section in mind. Its services are organized into communication, coordination and cooperation services. The services are placed at the disposal of the teachers during creation and updating of courses, allowing them to select and to configure those that will be made available to the participants.

The communication services include an asynchronous text discussion tool in a newsgroup style (*Conferences*), synchronous text chat (*Debate*), instant message exchange between simultaneously connected participants (*Messages for Participants*), and individual electronic mail with the mediator (*Contact with the Teachers*) and with the entire group (*Discussion List*). The coordination services include a notification tool (*Notices*), a tool for the basic coordination of the flow of the course (*Lesson Plan*), evaluation tools (*Tasks* and *Exams*) and a tool for following group participation (*Follow-Up Reports*). The cooperation services include a course reference list (*Bibliography* and *Webliography*), a list of transferable content (*Download*) and co-authoring facilities, both for teachers (*Teacher Co-authoring*) as well as learners (*Learner Co-authoring*). In the following section, some awareness elements of the AulaNet learningware are shown.

3.1. Awareness Elements in the AulaNet Learningware

Awareness elements are the interface elements through which information designed to provide awareness is made available. These elements should be taken into account when designing groupware. Which awareness elements will be needed, how they should be generated, how to join them up and how to distribute them must be foreseen. In this section, we will discuss some of these aspects with regard to the AulaNet environment.

The awareness information must provide individuals with a vision of what they will find in each one of the services, to enable them to decide which one to use and to have a notion about the total volume of work that is pending. This information must be summarized in a manner that the participants may quickly obtain a notion about the quantity and the characteristics of the work to do, avoiding information overload.

On the AulaNet, whenever a list of topics is presented, as is the case of the class topics in the *Lesson Plan* or the

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[1] http://guiaaulanet.eduweb.com.br

Conferences forum, the quantity of unread items and the total of items of that topic are shown. Other awareness elements include the name and a description of the topic, previously supplied by the teacher, and the name of the content provider who created it. At the end of the list, totals of the quantity of topics, of the items and of the unread or unsolved items are provided.

In order to navigate around the course, participants use a menu of services graphically represented by a remote control unit (Figure 3) that supplies navigational facilities built upon previous selections by the teacher of the services. Awareness information can be observed on the remote control unit. In the upper part is the course code, offering an individual awareness element for localization and context. The remote control items make the participant aware of the services available at a given moment. Next to each menu item is a circular button. This button changes color in order to

Figure 3. Remote Control

provide information about the services. A blue button indicates the service that the participant has selected, showing his location. A light orange button (highlighted in Figure 3) indicates that possible actions need to be taken. Upon moving the mouse over the button, one sees the number of items upon which some action should be taken (items not read or not solved). A dark orange button indicates a service where no changes have taken place since the last access. This awareness information is designed for individuals and helps them coordinate themselves.

The AulaNet *Debate* service, implemented as a textual chat application (Figure 4), provides a shared space where the information transmitted in the messages is displayed (area on the left) and an expression element where the participant can send his/her message (area on the bottom). Besides these elements, the AulaNet *Debate* service also offers a coordination awareness element. The area on the right displays participants who are present in the debate session.
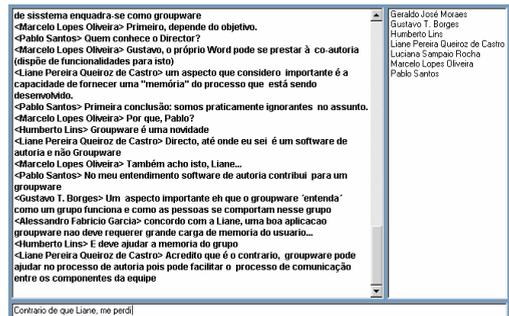

Figure 4. AulaNet Debate Service

In this tool, there is no explicit coordination mechanism to organize the group; therefore, the coordination is solely based on the social protocol. The Mediated Chat 2 application (Figure 5) was designed to deal with situations where there is a stronger need of explicit coordination [17]. There, the course mediator has coordination mechanisms to define the dynamics of the debate, based on conversation styles (circular conversation, voting pool, unique contribution etc.). Regarding awareness elements, every time the course mediator changes conversation styles, a message stating the new style appears in the chat area. If the participant cannot send a message (it is not her turn or she was silenced), her send button is made dimmed. In this application, other new awareness elements are: the topic in discussion, message timestamp, the information of who are the mediators, the order of contribution etc.
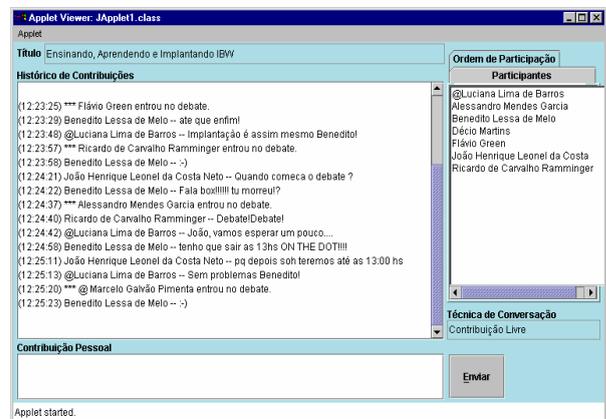
Figure 5. The AulaNet Mediated Chat 2

Upon listing the messages of the environment's asynchronous communication services, awareness information is offered in order to help participants contextualize the message, decide if it is the proper moment to access it or to locate something that is being sought. The category, the subject, the author, the date and the assessment of each message are shown. Besides this information, the messages that still have not been read are in bold face, indicating that action needs to be taken. In the specific case of *Conferences* and *Contact with the Teachers*, where it is possible to explicitly answer the messages, another piece of awareness information that is presented is the nesting of the messages. Through nesting it is possible to identify the connections between the

messages, facilitating the understanding of the context. These awareness elements mix individual awareness (things related to the individual work, like the indication of unread messages) with group awareness. The group awareness is related to the cooperation objects, which in this case are the messages exchanged and the discussion threads.

The AulaNet offers a service called Follow-Up Reports (Figure 6) that seeks to enhance the group awareness about its members' activities, providing subsidies for coordination. The reports summarize the quantity, extracted automatically by the environment, and the quality of contributions, supplied by the course mediator. Each contribution—messages, participation in debates, submission of content and resolution of tasks—are marked and, in the majority, commented upon by the teacher.

Participants	Discussion List 0 (0)	Conferences 8 (6)	Debate 8.08 (4)	Average Concept 8.63 (10)
Adriana	Without concept	Good / 9.82	Very active / 9.5	9.69
Gustavo	Without concept	Regular / 7.12	Very active / 9	7.48
Hiran	Without concept	Regular / 7.61	Very active / 8	8.37
Judith	Without concept	Good / 9.5	Very active / 9.5	9.5
Leonel	Without concept	Good / 9.29	Active / 6.88	8.32
Márcio	Without concept	Regular / 7.75	Very active / 9	8.85
Mariano	Without concept	Good / 10	Very active / 9.38	9.75
Pedro	Without concept	Good / 9	Very active / 9	9
Renata	Without concept	Good / 9.24	Very active / 9	9.15
Rodrigo	Without concept	Regular / 7	Low active / 3.33	7.33
Weight	0	6	4	10

Figure 6 – Follow-Up Report

The reports give an average rating of each participant per service, an average percentage for effective contributions, frequency of participation in the debates, the number of contributions per service and detailed reports for each service of the course. These reports make it possible for learners to check their performance and compare them with that of colleagues through information that is continuously updated. Furthermore, it helps the participants get to know each other better, to have a notion of how the course is going, of their roles within it and to choose other colleagues to form work groups. It also lets the mediator organize, motivate and evaluate the learners and check up on pending tasks.

4. Conclusion

According to the 3C collaboration model presented in Section 2, in order to work in a collaborative fashion an individual must argue (communicate), be in tune with the other members of the group (coordinate) and operate together in a shared space (cooperate). By being aware of the activities of other colleagues involved in the work and of the impact that occurs in the knowledge generated through collaboration, the participants will have

information that helps in the synchronization of the work, coordinating themselves around their individual contexts.

Awareness is relevant for both individual and group work. Examples of awareness information that helps individual work are showing what messages an individual already has read, what are the new items since the previous visit, etc. Information about who is currently present in the environment, who is working with an artifact, among others, is oriented towards working in a group. Despite this separation, information must be designed to be complementary and to help individual work during the collaboration [10].

There are various classifications about awareness information in the literature [9] [14]. Some aspects involved in these classifications are purpose, time, scope, abstraction, aggregation, perspective, form of supply and customization [2]. For all the parts of the system one must ask questions of "who, what, where, when and how" to seek to identify what information the users must have in order to grasp the situation and provide understanding.

After identifying which information is necessary, one should analyze how it could be obtained. It can be generated explicitly by the individuals or extracted by the environment. For example, upon sending a message to a *Conference*, some information is automatically extracted such as, for example, the date of transmission and the sender. But there is other information, such as the category, the title and the body that need to be supplied by the author through expression elements. The automatic extraction of the information that is necessary to provide awareness frees the participants from having to do so, which speeds up interaction. On the other hand, by having to supply information about their activities, participants are led to reflect before acting, which is desirable, especially in asynchronous interaction [8].

Once awareness information and the way to obtain it have been identified, an analysis should be conducted of how it could be gathered and distributed. The choice of an adequate means of implementing the awareness elements helps to avoid information overload and the poor interpretation of data. In order to choose the appropriate means, factors such as the importance of the information and how often it changes must be taken into consideration.

The appropriate way of creating an interface that makes awareness information available is beyond the scope of this paper. Aspects of the graphic project should be taken into account as well as the media to be used and cognitive aspects, among others. Ideally, the groupware developer will have the assistance of an interface designer.

In some cases, the environment must provide some type of control over the information so that the users may adjust their level of receiving information to their preferences and their availability, avoiding, for example, that they are interrupted or distracted by irrelevant information during moments when they are very busy or in a hurry. Similarly, some information is absolutely essential and must unconditionally be shown to the group

[3]. Moreover, it is necessary that there is control regarding privacy; after all, there is some type of information that the individual would not like to be recorded and/or made available to certain persons.

It is worth remembering that some awareness information needs to be approved to be considered. For example, this occurs in the AulaNet in the Learner Co-Authoring and in Debate sessions. In the Co-Authoring service, a learner submits content he has produced to become part of the course, although the content is only incorporated if the teacher accepts it. In a debate, the sessions are registered only when the course mediator explicitly does it.

A suitable design of an application's interface will make available the specific awareness elements that allow the participants to have the necessary information needed to carry on with their work. However, it is not possible for the designer to define a priori which awareness elements will be appropriate and sufficient to convey the awareness information that is relevant for the participants in each and every moment. This process must be continuous and experimental in order to adapt the elements to the real requirements of the individuals. It also is worth remembering that each participant has her own skills, requirements and preferences. Thus, the elements must be flexible to adjust to different personal styles without overly complicating the use of the environment or making it possible to distort it. Furthermore, care must be taken to control the flow and the quantity of awareness information to be disposed so that individuals do not feel overloaded. Regarding AulaNet, some interviews were held and questionnaires filled out to evaluate the effectiveness and appropriateness of the awareness elements chosen.

The model presented in this paper, where awareness occupies a central position, could help groupware designers to define the elements and the sources of awareness, separating the needs in communication, coordination and cooperation classes.

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