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Supporting members of a learning community using Interaction Analysis tools: The example of the Kaleidoscope NoE scientific network

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Abstract

Communities of Practice (CoP) are nowadays widely used for implementing collaborative learning approaches, under the scope of contemporary learning theories. Several communication and/or collaboration web modules are used in order to support the organizational structure and facilitate the operational purpose of such communities. Following the same approach, Scientific Networks (SN) are widely used as a common method of expanding research and sharing academic resources. The need for appropriate tools in order to support the members of a CoP or a SN and further facilitate their collaborative tasks, or even resulted learning is often highlighted by the literature. In this paper we propose the use of Interaction Analysis indicators for that matter. Our experience from the implementation of such indicators, supporting the Kaleidoscope Network of Excellence is presented.

1. Introduction

A *human network* is a social structure, consisting of people who share one or more common features, such as visions, ideas, values, etc. In the case of networks composed of collaborating scientists, also known as *scientific networks* (SN), collaboration based on the exchange of ideas, resources and perceptions, along with a joined research effort takes place for achieving the prescribed tasks. When using ICT technologies, appropriate Communication and Collaboration Infrastructures (CCI) are needed in order to facilitate teamwork and task distribution, including discussion platforms (asynchronous and/or synchronous), mailing lists, shared workspaces and portals.

Wenger argues that *communities of practice* (CoP) are groups of people who share a concern or a passion for something the do and who interact regularly in order to learn how to do it better [1]. To define a CoP, Wenger considers three crucial characteristics: a) *the domain* of interest which the community's members share, b) *the community* sense which is developed when members engage joined activities and discussions, help each other and share information, and c) *the practice* itself which is the key aspect that defines a CoP from any other forms of communities. This practice takes time and sustained interaction while accomplishing the predefined goals.

Closely examining the above descriptions, it is obvious that a SN is in fact a form of a CoP. In both cases, interaction among the members is the key to fulfilling the desired tasks. In the ICT era, much of the interaction takes place through CCIs.

We propose the use of Computer-based Interaction Analysis (IA) tools, in order to further facilitate the collaboration and coordination within such a structure. IA can be defined as the automatic or semi-automatic processes that aim at understanding the computer mediated activity, drawing on data obtained from the participants' activities. This understanding can serve to support the human or artificial participants to take a part of the control of the activity, contributing to awareness, self-assessment or even selfregulation.

In this paper, we present our experience from the design and implementation of IA support tools for the members of the *Kaleidoscope Network of Excellence* (NoE), which is used as an example in order to illustrate and discuss upon the proposed approach. The paper is structured as follows: The Kaleidoscope NoE is sententiously described, related work is investigated and the field of IA is briefly presented. Then our approach is described and examples are presented, before concluding our discussion.

2. Kaleidoscope NoE

The *Kaleidoscope NoE* is a SN of more than 1000 researchers from over 20 countries, who work collaboratively across the educational, computer and social sciences research areas. According to Wenger's definition, the Kaleidoscope NoE is actually a CoP, with academic research on the field of Tecnology Enhanced Learning being the domain of interest which the members share. They operate as a CoP by collaborating within joined activities and interact, while trying to fulfill the corresponding, prescribed tasks.

One of Kaleidoscope's joint activities was the implementation of a CCI which integrates several tools for the collaborating members. The main CCI interface is a portal (http://www.noe-kaleidoscope.org/), accessible by both authorized members and anonymous visitors, leading to various free and restricted resources (announcements, project deliverables, news, joint activities' subportals, etc). Additionally, members have their own profiles, thus sharing their expertise, research interests and personal information. Within this infrastructure, communication opportunities are encouraged, following one of the fundamental aims of a CoP.

CCI-IA was another joint activity, having the general objective of examining and prescribing how Kaleidoscope could develop and apply IA, in order to support the members of the SN (in their various roles), on the level of awareness and metacognition, thus facilitating the *practice* parameter of the *community* activity, by enhancing *collaboration* and *interaction* among the participants.

3. Related Work

Several tools exist for the support of electronically mediated Communities of Practice, constituting a CCI. As Hiltz [2] asserts, developing and simply making available such a tool does not ensure its use. Usually this results in poor or no usage at all; thus further facilitation is required. Under the same scope, Kollock [4] emphasizes the following three general design principles for online community building, based on the principles of social interaction and collaboration: 1) arrange that individuals meet each other again; 2) individuals must be able to recognize each other; 3) individuals must have information about how the other has behaved in the past.

Adopting these principles, we consider the existence of supporting tools, appropriate for enhancing communication, collaboration and group well being, a necessity. Reviewing the literature, we can find many supporting tools, such as awareness and Group Decision Support Systems (GDSS). Furthermore, most of the modules which constitute a CCI usually integrate analysis, statistical mainly, add-ons, providing information which aspire to provide added value to the modules themselves. Most of the existing approaches are proposals made within the Computer Supported Collaborative Learning (CSCL) and Computer Supported Cooperative Work (CSCW) fields.

In this paper we describe our experience from the implementation of IA tools in order to support the members of a SN while in *practice*, through the Kaleidoscope NoE CCI.

4. Interaction Analysis

The IA process consists in recording, filtering and processing data regarding system usage and user activity variables, in order to produce the analysis indicators. These indicators (presented usually in a visualized form) may concern: a) the mode or the process or the 'quality' of the considered 'cognitive system' within the learning activity; b) the features or the quality of the interaction product; or c) the mode, the process or the quality of the collaboration, when acting in the frame of a social context forming via a technology based learning environment [3].

The IA results are presented to the participants in an appropriate format (graphical, numerical, literal), interpretable by them. The corresponding information provides an insight on their own current or previous activity allowing them to reflect on a cognitive or metacognitive level, and thus act in order to self-regulate their activities. Additionally, IA provides information to the activity observers-moderators, in order to analyze the complex cognitive and social phenomena that may occur. This approach can produce flexible IA tools, which support directly technology-based activities' participants.

IA tools can support different functionalities, based on the understanding of the social processes and the possibilities of intervention, in order to improve collaboration (in a wider perception of the term). Examples of these functionalities are awareness, regulation and evaluation of the collaborative processes. These functionalities are oriented to different types of users; e.g. *evaluation* can be oriented to teachers and *regulation*, to students.

Studies in several fields can be found, showing how the needs of collaborating users are different. In the CSCL (Computer Supported Collaborative Learning) field, for example, it is possible to discriminate different metacognition and visualization needs for two types of users, students and teachers [4]. In [5] the authors analyze the effect on students' behavior (individual, collaborative and cognitive, metacognitive), when providing various IA information of collaborative learning activities to them, whereas in [6] they analyze the importance of applying the proper interpretation approach to the visualized IA information. In the CSCW (Computer Supported Cooperative Work) field we can find awareness systems and tools that propose adaptation to different users [7], [8]. They repute that depending on his role during the collaborative process, the user should access a specific type and amount of awareness information. They assume that the key issue is to provide exactly the right type of information for a given *participant* in a given *role* performing a given *task* [8]. From the experience of these awareness systems it can be deduced that collaboration-support tools would benefit from considering this aspect, in order to improve the collaborative processes.

Following these findings, we propose the provision of IA information to the members of a SN, in order to support their collaborative *practice*, in matters of coordination, regulation, planning, performance and well being. Different information is presented to different members, according to their needs, as they are prescribed by their various roles. Users in a collaborative activity have different IA information needs according to the role functions that they undertake in the activity and depending of diverse aspects related with the context, such as the specific task (e.g. collaborative edition), the environment type (e.g. synchronous or asynchronous), the age or educational level of participants (e.g. students, researchers, professors), the number of participants (e.g. small group, large group, communities) or the IA purpose. If IA tools considered the different roles, implied in the analysis processes, and their needs, this could permit the exploitation of the interaction analysis results according to who is the user and what is his/her purpose [9].

5. IA tools for Kaleidoscope NoE

In order to propose IA tools for the Kaleidoscope CCI, we initially had to prescribe the design principles. Then the informational needs of the users had to be researched in order to produce the appropriate tools. The design and implementation process is described in the following subsections.

5.1. Design process and principles

Before designing and implementing IA tools for the Kaleidoscope NoE CCI, we wanted to identify and categorize the existing user roles and corresponding needs, based on their organizational, managerial and educational roles. A questionnaire was used in order to further justify the initial categorization and confirm the appropriateness of the proposed tools. Furthermore a detailed recording of the collaboration facilities (discussion boards, shared workspaces, etc) in use was achieved.

While designing the proposed tools and ideas, the following principles were specified:

The tools must be customizable and flexible: The visitors of a SN portal have various roles and belong in different categories. Different sets of indicators should be provided to different kinds of users/visitors.

The tools must be interoperable: Many technologies exist for the same kind of service. For example, tools performing log file analysis should produce similar, if not exactly the same results, for as many kinds of web servers as possible.

Ethical considerations: Not every user may be able to see every available indicator for ethical reasons. For example when using an indicator related to the fulfillment of a task by the deadline, a leader should be the only one to access the corresponding information. The purpose of the indicator is not to “expose” non-punctual members to every other member.

User notification: The visitors/users should be informed about the indicators usage, upon site entry, in case they disagree and are unwilling to participate.

Indicator Codification: User information appearing in any indicator may need to be codified. For example only numerical data or abstract information may appear, preventing appearance of names, in order to reduce any possible embarrassment of the users.

Non competitive indicators: A delicate issue in IA is that of accidentally promoting unnecessary competition between a network’s members via indicating usage information. Thus during indicator design, this should be considered carefully.

5.2. IA tools - Implementation

Two general categories of IA tools were distinguished: a) web site IA tools and b) web based service’s (additional collaborative modules) IA tools. Regarding the first category, two different, complimentary methods of data acquisition were used: a) web server log files and b) databases in which detailed visitation information for all members was automatically recorded. Following this approach, when a user accesses the Kaleidoscope CCI, his/her actions are recorded automatically in the web server log file. Additionally, enriched and refined information is also recorded in a database.

Analysis was performed using either existing web log file analysis software or custom built analysis of web resources manipulation and visitation.

Thirteen IA indicators were implemented and divided into four categories:

Site Visitation Indicators: This category includes three indicators, presenting general information, related to site visitation for a selected time period. They are: a) Unique Visitors per Time Slot, b) Visits per Time Slot, and c) Traffic Rates

Resource Visitation Indicators: This category includes three indicators, presenting information related to the visitation of specific resources, such as the most popular pages/resources and entry or exit points (initial of final resource accessed during a visitation session). These indicators are: a) Most Popular Pages/Resources, b) Most Popular Entry Points, and c) Most Popular Exit Points.

Resource Manipulation Indicators: This category includes four indicators, presenting information related to the authors, metadata and accessing information of the published material in the Kaleidoscope CCI. They are: a) Resources Published by a Single Member, b) Resources Published by Role, c) Visitors who have accessed a Resource/Page, and d) Resources related to a given Resource/Page.

User Behavior Indicators: This category includes three main indicators, presenting information revealing more insightful aspects of the visitors' behavior and habits within the Kaleidoscope CCI. They are: a) Most Active users, b) Relevant Users, and c) Social Networks (combined indicators that visualize sub-networks within Kaleidoscope).(Figure 1).

All the IA indicators are presented in graphical and/or literal form. They are described in detail in [10].

For additional collaboration modules (shared workspace and discussion forae), the use of special software was suggested (SAMSA [3] and DIAS [5], [6] accordingly).

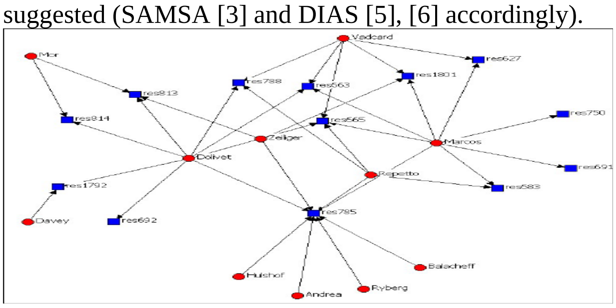

Figure 1: SNA indicator

6. IA indicators in use

In order to demonstrate the usefulness of the IA indicators, we present a representative example of how the deriving information can be exploited.

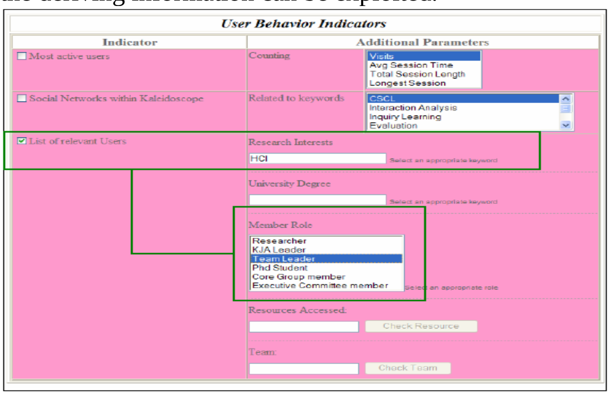

Figure 2: Search for relevant users – Selection form

For this example, we exploit the indicator *Relevant Users*, using a combination of search criteria: a) *member role*, and b) *research interest*. Let us consider someone who tries to locate relevant researchers, members of the Kaleidoscope NoE who are leaders of research teams (e.g. university laboratories) and are interested in HCI (Human Computer Interaction). Filling the selection form (Figure 2) with the appropriate keywords (HCI, team leader), a list of results is displayed (Figure 1), providing links to the personal profile pages of the team leaders, as well as to the web pages of their research teams. From that point on, the user may contact some of the revealed members, thus initiating communication and possible future collaboration or further seek more of their work (e.g. publications, etc).

Researchers with similar interests are relevant to others, in order to collaborate with them in several ways: perform joined experiments, participate in common research projects, etc. Assuming the research interests of team leaders summarize their group's interests, the information obtained with this indicator can help a user to know which Kaleidoscope teams are working in the same research fields. After obtaining this information, the users can easily follow different strategies on the IA site depending on their purpose. The least obtained through such information is the broadening of formal or informal communication and collaboration opportunities among scientists, which can increase information and knowledge exchange/diffusion and provide new research possibilities.

Following this example, we tried to demonstrate how simple IA information, based on proper codification, recording and most importantly interpretation [6], can increase the possibility of fruitful collaboration by creating additional communication channels. Additional examples, some of which are more complex and assist the members of a SN in multiple ways (e.g. make decisions, optimally navigate within the CCI, etc) are described in [10].

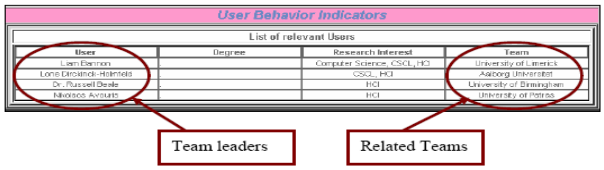

Figure 3: List of relevant users (results)

7. Evaluation of the CCI-IA platform

A fully functional IA Service was designed and implemented, providing: a) IA indicators, b) user support features, and c) support for all the parties interested in implementing such tools in their CCI. It was then formally evaluated. The first goal of this evaluation was to analyze its impact on the Kaleidoscope community, as well as to disseminate this service in an indirect way. On the other hand, evaluation was extremely useful in order to be able to enhance the service and collect new requirements, given the fact that this task was a very complex one, regarding development and deployment, with limited resources allocated to it.

The evaluation method was based on questionnaires filled out on-line with qualitative and quantitative answers. Additionally, a selected set of Kaleidoscope members was interviewed orally in order to provide much more insight on the context, problems, etc.

Overall, the users' opinions were positive, providing us with additional ideas for improving the service. For example, indicators returning a list of resources were improved by including a mark, indicating whether they had been already accessed by the interested user. The users also expressed the need for more "assistance" while using the IA tools, which lead us to include default values for the required parameters, as well as a set of usage cases that demonstrated ways of exploiting the tools, as many users seem to lack the expertise and the culture of utilizing such tools. Furthermore, users were asked to complete a table, grading various aspects of the proposed IA indicators and, optionally, justifying the grade. In all cases a scale varying from one (Not good) to five (Very Good) was used. Overall, the global appreciation was positive, although the sample is not statistically significant. In addition, the indicators were considered easy to understand (transparency).

8. Conclusions

In this paper we have presented our approach of providing a concrete SN with IA tools to support its collaborative tasks and well functioning. This approach can be differentiated from the existing web site visitation analysis tools, as the latter produce rather limited information when attempting to utilize it for purposes, such as organizing and regulating individual and group activity, making decisions related to collaborative aspects and studying the social aspects of a human network. Our approach relies on recording raw activity data and applying IA techniques, along with proper interpretation schemes, in order to provide meaning, context and various points of view/analysis to people actions. Such a task is hard to accomplish with simple, automated analysis tools (e.g. web log analyzers), as they are mainly addressed to system administrators, providing them with simple statistical information.

Using an approach, such as the one described in this paper, data analysis is more flexible and extensible. Most of the commercial (or free) systems are usually restricted and purpose oriented. Thus it is not easy to apply different points of view when analyzing activity data, in order to support a community of collaborating researchers. By recording data in a manner, such as the one followed throughout our approach, it is rather easy to apply more complex analysis techniques, such as Social Network Analysis, which may reveal several interesting and important information, as stated in [11].

Concluding, we predicate that IA supporting tools may evolve to very useful and powerful facilitation of Scientific Networks' well performance and collaboration. More extensive evaluations are necessary in order to draw conclusions regarding the type of IA indicators that are more useful. This might also depend on the users and the context of the collaboration. These results can also be applied in CoP, following the wider definition of the term, facilitating and enhancing collaboration and/or interaction. Thus *learning in practice* can be further promoted, given that *extensive collaboration* and *communication* within a team is the *key aspect* of contemporary learning approaches, which underlie CoP. Overall, it is expected that further research will be undertaken during the next years in this direction, as there is limited work in this area, and the related aspects proclaim an increasing interest.

9. Aknowledgements

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10. References

[1] S. Cummings and A. van Zee, "Communities of practice and networks: reviewing two perspectives on social learning" KM4D Journal 1(1), 8-22, 2005.
[2] S.R. Hiltz, "Impacts of college level courses via asynchronous learning networks: Some preliminary results". *Journal of Asynchronous Learning Networks*, 1(2), 1997
[3] A. Dimitracopoulou et al., "Basic Needs' Identification of Computer Based Interaction Analysis for NoE members' support. Kaleidoscope CCI," Deliverable D.34.4.1. Kaleidoscope NoE, 2005. Available at www.telearn.org
[4] A. Dimitracopoulou, **"**Designing collaborative environments: Current Trends and Future Research Agenda". In D.Suthers & T. Koschmann (Eds). CSCL 2005: the next ten years. 30 May-4 June 2005, Taipei, Taiwan.
[5] T. Bratitsis and A. Dimitracopoulou, "Interaction Analysis in Asynchronous Discussions: Lessons Learned from the Learners' Perspective, using the DIAS system". In C. Chinn, G. Erkens and S. Puntambekar (eds): Proceedings of CSCL2007 Conference – Mice, Minds and Society, 87-89, ISLS, 2007.
[6] T. Bratitsis and A. Dimitracopoulou, "Interpretation Issues in Monitoring and Analyzing Group Interactions in Asynchronous Discussions". *Int Journal of e-Collaboration*, 4(1), 20-40, 2008.
[7] P. Dourish and V. Belloti, "Awareness and coordination in shared workspaces". ACM Press. Proceedings of the CSCW Conference; Toronto, Canada. ACM Press, 1992.
[8] J. Drury and M.G. Williams, "A framework for role-based specification and evaluation of awareness support in synchronous collaborative applications". Proceedings of the 11th Int Workshops on Enabling Technologies for collaborative enterprises (WETICE02); Pittsburgh. IEEE Press.
[9] J.A. Marcos, A. Martínez-Monés, Y. Dimitriadis and R. Anguita-Martínez, "A Role-Based Approach for the Support of Collaborative Learning Activities", *e-Services Journal*, 6 (1), 2007

[10] T. Bratitsis et al., "IA tools test and IA Service" Deliverable D.34.4.4. Kaleidoscope NoE, 2006. Available at www.telearn.org

[11] A. Harrer, N. Malzahn, S. Zeini, S. & U. Hoppe. "Combining Social Network Analysis with Semantic Relations to Support the Evolution of a Scientific Community". In C. Chinn, G. Erkens and S. Puntambekar (eds): Proceedings of CSCL2007– Mice, Minds and Society. ISLS, 267-276, 2007