Personalization Services in Argumentation Tools: a Catalyst for Learning

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Abstract. Argumentation is considered as an essential element for effective learning since it enables learners to develop their points of view and refine their knowledge. Our aim being to facilitate CoP members as learners, we argue that argumentation tools should provide personalized features and functionalities in order to fit the specific individual and community learning requirements. More specifically, we propose a set of personalization services that can act as catalysts for individual and community learning. The proposed set of services has derived after the careful consideration of a generic Learner Profile, developed to formalize human actors in settings where learning takes place.

1 Introduction

As organizations start to acknowledge the significance of *Communities of Practice* in helping them meet their business needs and objectives, new efforts to better understand the processes of learning in these communities are constantly emerging [1]. The term Communities of Practice (CoPs) is commonly used to define groups of people who share an interest in a domain of human endeavour and engage in a process of collective *learning* that creates bonds between them [2]. Such communities are formed by groups of people having similar interests or goals, and are willing to share their knowledge, in-sights and experiences about specific work aspects, the ultimate aim being to learn from each other [3]. As stated in [2, 3], the key aspect to successful learning within a CoP is the provision of the proper means for information exchange and peer-to-peer collaboration so as to enhance the organizational knowledge flow.

On the other hand, modern learning theories support the value of communities and collaborative work as settings for learning [4]. As regards to collaborative learning, an especially valued activity is *argumentation* [5], meaning the process of introducing, supporting or defeating a set of alternative courses of action, based on structured arguments. More specifically, argumentation is considered as an essential element for effective learning since it enables learners to develop their points of view and refine

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their knowledge. This is because, during collaborative argumentation processes, participants focus on the same issues, share their knowledge and learn to negotiate conflicting opinions in order to reach a commonly accepted solution [6, 7]. As stated in [8], on-line collaborative argumentation can serve as a tool for informal learning situated in the context of CoP members everyday work experience. Still, it is generally acknowledged that traditional software approaches supporting argumentation are no longer sufficient to support contemporary communication and collaboration needs [9]. This is because they are focused in the logical structure of the argumentation, and they do not provide the means to support learning.

In our approach, argumentation tools are knowledge sharing environments where learning is taking place in the exchange of problem interpretations, interests, objectives, priorities and constraints, which may express alternative, fuzzily defined, or even conflicting views. In this vein, argumentation tools should satisfy the community members' needs to construct and refine their ideas, opinions and thoughts in meaningful ways, in order to successfully assist individual and community learning. At the same time, individual standpoints should be articulated in such a way that can be proven useful for the rest of the community's members. In addition to that, support should be offered for the development of learning skills, such as the interaction with other actors, as well as growth of the learners' autonomy and self-direction. Moreover, identification of CoP members' individual characteristics, as well as the culture, norms and incentive schemes of the community should be appropriately handled. For this, personalization services should be provided, so as to promote learning and to encourage creative, parallel and lateral thinking during argumentation.

In the following we present a set of proposed personalization services that has been developed to address the abovementioned requirements for the efficient and effective learning between CoP members during argumentative discourses. Towards this aim, we first performed a comprehensive literature and practice survey of related issues regarding Communities of Practice, Argumentation and Learning. Based on the findings of this research, we concluded that personalization services could enhance learning in both existing and to be developed argumentation tools. In order to propose a set of personalization services suitable for CoP members, we developed a generic Learner Profile model to formalize CoP members as human actors in settings where learning takes place. Our aim being to facilitate CoP members as learners, we present in this paper a set of personalization services for tools facilitating argumentation that can act as catalysts for individual and community learning. More specifically, we propose the development of a virtual environment for collaborative argumentation providing personalization services in accordance with the proposed Learner Profile. We envisage this as an environment where learners are able to express personal ideas and opinions, being provided with the proper means for the articulation and sharing of the learners' knowledge.

The remainder of this paper is structured as follows. Section 2 presents the proposed Learner Profile model. Section 3 presents the proposed set of personalized services towards learning and their relation to the proposed Learner Profile. Furthermore, it discusses implementation issues regarding the embedment of the proposed set of services to existing or under development argumentation tools. Section 4 pre-

sents a discussion about existing argumentation tools. Section 5 concludes this paper with some final remarks and our future work directions.

2 The proposed Learner Profile

Taking the above issues into account, we acknowledge learning as a major part of CoPs activities, and we argue that one of the most significant roles undertaken by almost all CoPs' members is the role of a learner. Related research findings about learners' modelling prove that due to the complexity of human actors and the diversity regarding the learning context, the development of a commonly accepted learner profile is a highly complex task [10]. For instance, the Learner model in [11] depicts a learner as a concept hierarchy but it does not refer to issues such as the learning object, or the learners' interactions with their environment and other people. However, it provides interesting information about a learner's cognitive characteristics and it provides a representation of knowledge assessment issues. Another related approach, the "PAPI Learner" conceptual model comprises preference, performance, portfolio, and other types of information [12]. Yet, this model includes only the minimum information necessary to satisfy the functional requirements and be maximally portable, and it does not provide any information about a learner's profile dynamic aspects. The IMS Learner Information Package specification [13] is a useful collection of information that addresses the interoperability of internet-based Learner Information systems with other systems that support the Internet learning environment. But, the aforementioned approaches cannot be employed for the representation of a community as a learning entity.

After the careful consideration of the above approaches, we developed a generic Learner Profile that can be employed for the representation of both individuals and communities as learners (see Fig. 1). Thus, the proposed model can be employed for developing customized services for both individual and group learners. More specifically, the proposed Learner Profile consists of two types of information, namely *static information* and *dynamic information*. Static information comprises information about the name, contact details, education, training, working experience etc. of the CoP members, as well as information about the CoP(s) they belong to. Such information is considered as domain independent in our approach. The Learner Profile dynamic information elements were chosen to reflect one's individual behaviour during his participation in a specific CoP's argumentation activities. Thus, all four dynamic elements, i.e. *preferences*, *relations*, *competences* and *experience* are to be implicitly or explicitly defined through the learner's interaction with a tool supporting collaborative argumentation. *Preferences* regarding the use of resources and services provided by the tool, as well as *relations* among individuals, CoPs and learning items (e.g. argument, URL, or document) can reveal the learners' different personality types and learning styles. *Competences* refer to cognitive characteristics such as the creativity, reciprocity and social skills. *Experience* reflects learners' familiarity and know-how regarding a specific domain. It should be noted that all dynamic elements of the proposed Learner Profile can be of assistance towards learning. Nevertheless, the

domain of the issue under argumentation is a decisive factor. Thus, dynamic aspects of a learner's profile are treated as domain specific in our approach.

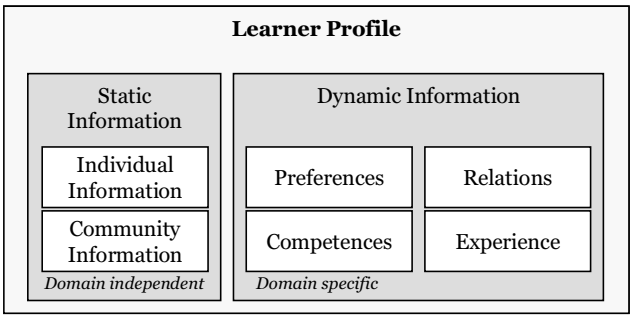

Fig. 1. The proposed Learner Profile

3 The proposed set of services

Perceiving users as learners, in the following we present a set of services that can augment argumentation tools towards facilitating individual and community learning activities. The proposed set of services has resulted out of a thorough investigation of the related literature, including case studies that consider diverse aspects of learning within a CoP. More specifically, CoPs consider *system awareness services* as one of the most valued services for argumentation tools. This kind of services comprises a set of notification actions for the provision of helpful personalized information about system events to CoP members. Such events could be the entrance of a related learner to the system, the creation, termination or any other related action over a specific discussion and the notification about the insertion of new content into the system (arguments, documents etc.). In order to enable this personalized awareness, terms such as "related" or "interesting" that define a relation between the learner and the content should be determined by the learner himself or automatically by the system through the manipulation of some characteristics from the user profile.

Personalized searching is another service that can facilitate learning activities, especially for autonomous learners. During searching, a Learner's Profile can provide useful information to rank search resources according to a number of factors, such as the learner's preferences, or even his competence and experience level. In this way, the system will be able to adapt to an individual user's needs. Moreover, the information about the user's domains of interest will provide additional information with which a search can be better contextualized, thus leading to more relevant results. Furthermore, reasoning mechanisms could be employed for providing the necessary filtering features for capturing and reusing the knowledge shared in past argumentation activities.

Another issue to be carefully treated regards the representation and visualization of arguments so as to assist the participants to better organize their thoughts and present them in a more clear way to the others. *Personalized presentation* of context can provide learners with a working environment that fits to their preferred visualization style. System personalization includes alterations in colours, fonts and text effects, enabling and disabling pieces of information in the working panel, predefinition of system responses in user actions etc. In this vein, filtering and recommendation of content services can further support learning. Content that is inserted in the system should be filtered according to each learner's preferences and be recommended as interesting incoming information. For instance, some of the attached documents of posted positions that contribute to the strengthening of an argument should be suggested for view. Furthermore, a document library could recommend some documents that are related to a specific learner (e.g. experienced learner's recommendations or popular documents).

Learner expertise and action tracking services can also assist learning in the community. Such services enable the community members to find and communicate with their co-workers in a more knowledgeable way. Furthermore, if coinciding with a community's norms and wills, such services could also be used for the assignment of weights regarding the weight of a member's arguments. Such services could be based on the learners' level of experience (as recorded in their profiles), in addition to attributes deriving from the users' participation in the community's activities.

Finally, *privacy policies and access control services* are a critical requirement for the employment of all the above services. These should be provided in order to satisfy the learner/users' need to know what information about them is recorded, for what purposes, how long this information will be kept, and if this information is revealed to other people. Platform for Privacy Preferences Project (P3P) is a W3C approach that supports the description of privacy policies in a standardized XML-based form, which can be automatically retrieved and interpreted by the user client [14]. Furthermore, the security assurance while establishing connections between users and services, or while accessing stored information, should be taken into consideration as well. Towards this end, two major techniques are broadly used to provide denial of access to data, i.e. anonymity and encryption. Anonymity cuts the relation between the particular user and the information about him, while information encryption provides protection of the exchanged personal data.

3.1 Acquisition of learner profile data

In order to enable the operation of the abovementioned personalized services, the Learner Profile has to be populated with the appropriate data. Such data can be acquired in two ways: *explicitly* from the users' preferences, and *implicitly* based on the users' behaviour within the system. The later could be based on a rule-based event engine. In this way, a personalized argumentation tool may comprise two kinds of personalization services, those explicitly and those implicitly initiated by the user. The former, refer to service approaches that adapt to the system based on the explicitly stated characteristics or preferences of the user. The later, refer to approaches that

implicitly adapt to the system based on the user's actions within it. Implicit personalization mechanisms are automatically triggered by the system utilizing data in the proposed Learner Profile. In the following, we briefly describe each acquisition method.

Static information of the Learner Profile is explicitly provided by the user, as a required initialization step of the registration procedure. While such information is usually provided when registering to the system, users should be able to edit this set of profile information at any time. Such explicit data acquisition constitutes a subjective way of profiling, since it depends on the statements made by the user (e.g. experience level, competences etc.). Their subjective nature may influence personalization services in an unpredictable way (e.g. suggesting to a novice user a document that requires advanced domain knowledge because the user misjudged his experience or competence level). To cope with such issues, we are currently in the process of designing methods that assess explicitly stated profile data, based on the users' behaviour. We refer to these ways as *implicit* or *behaviour-based data acquisition*.

In general, the aim of implicit or behaviour based data acquisition is to assess experience, domains, competences of an individual user based on the users behaviour, leading to a quantification of profile information which provide a more reliable information source for personalization and decision making services. Implicit data acquisition utilizes the users' actions and interactions and attempts to extract information that can permit assessing or augmenting a user profile data. Towards this aim, a rule-based engine is required that recognizes user interactions and system events, and triggers computations that modify the users' profile data.

In our approach, a rule-based approach has been chosen so as to facilitate incorporation of new rules once they are observed or modification of existing ones if they prove to be too restrictive or even harmful. More specifically, we propose the development a set of rules that deal with resource access, as access to resources are logged and a number of rules operate on the logged data to provide additional information to resources and/or user profiles. These can be based on the frequency of access and the competence and experience levels of users (e.g. a document that is frequently accessed by novice users should augment the documents metadata with elements that mirror this fact so that this document can be recommended to any novice user entering a discussion). A second set of rules observing discussion contribution could control how user behaviour in the context of discussions will affect the users' competence and experience (e.g. users that actively and frequently participate can be assigned with a high experience level). Another useful indicator associated to the proposed learner profile is the reasoning about how a competence level of a particular user changes in time. This may provide useful insights about the learning capabilities of the particular user and the usefulness of the system.

3.2 Implementation issues

According to current trends in developing web-based tools, for reasons such as the reusability of components and agility of services, our approach builds on top of a service oriented environment. In order to exploit advantages enabled by the Service

Oriented Architecture (SOA) design paradigm, the proposed set of services should be based on web service architecture so as to enable the reusability of the implemented modules, as well as the integration or the interoperation with other services (from external systems).

Considering the above, an overall design for the enhancement of existing argumentation tools with personalized functionality towards learning is depicted in Fig. 2. In this approach, we sketch a generic architecture design in which a Learner Profile Service is the basis for the storage and the provision of each learner's characteristics to a set of proposed services that contribute to the system's personalization. Considering the set of proposed services as non-exhaustive, this "architecture" is open for the addition of new personalized services (see Fig. 2, block "New Service") and can use the Simple Object Access Protocol (SOAP) for both internal and external communication, following the web services standards.

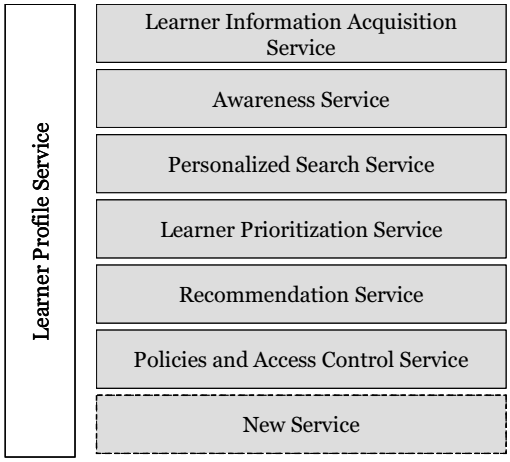

Fig. 2. The proposed services

4 Discussion

A major category of tools supporting argumentative collaboration provides the means for discussion structuring and user administration. *gIbis* [15], for instance, is a hypertext groupware tool that allows its users to create issues, make positions on these issues, and make arguments pro and contra these. *Sibyl* [16] a tool for managing group decision rationale. *QuestMap* [17] resembles to a "whiteboard" where all messages, documents and reference material for a project and their relationships are graphically displayed during meetings. *Compendium* [18] is a graphical hypertext system which can be used to gather a semantic group memory when used in a meeting scenario. *Araucaria* [19] provides an interface for the decomposition of text into argumentation premises and conclusions via a diagramming process. The *Rea-*

son!Able [20] argumentation tool provides a well structured and user-friendly environment for reasoning. Another educational software providing assistance in the creation and sharing of visual images of ideas is *MindDraw* (see http://info.cwru.edu/minddraw/), a thinker's tool that is useful for students and learners of all ages, from primary school through graduate training and professional practice.

The systems described above may be regarded as the most representative of a larger collection of argumentation systems. Nevertheless, a new generation of argumentation tools towards learning has emerged. For instance, in *Dialab* [21] is a logic game, aiming at assisting the development of the players' logic competency. The *Multiple Object Oriented* (MOO) [22] system is a synchronous, text-based environment where collaboration is established through the use of virtual spaces. Learning activities are modelled as problems to be solved through the scheduling of a virtual conference room. The *Collaborative Text Processing* (CTP) [23] system is a synchronous network-based word processor application. Activities take place through pairs of students that collaborate in this environment. An assignment which is given to the students ("task") and supporting information ("argument") are supplementary concepts that co-exist in the main word processor window. *CLARE* [24] is an asynchronous network tool aiming at supporting the task of collaborative knowledge construction. This task comprises two phases: *exploration*, which takes place individually and information is gathered to a common repository, and *consolidation* which takes place through evaluation, comparison and summarization of the information gathered. Finally, *Belvedere* [25] is a synchronous web-based learning tool designed for supporting learning activities. Belvedere provides an environment for constructing argumentation diagrams between individuals or groups of students. A special representation is used to declare the uncertainty level of the arguments submitted, whereas communication among partners is supported through chatting.

As derives from the above, existing tools facilitating argumentation primarily provide either visualization or collaboration functionalities, as they mainly focus on the expression and visualization of arguments. Argumentation tools developed for education support focus on the subject to be taught, not the learner. Existing approaches perceive users as static entities of the problem analysis, and even though they are efficient in terms of structuring a discussion based in argumentation, they do not provide personalized support, nor do they focus on collaborative learning activities taking place in such contexts.

5 Conclusion

In this paper we presented a set of services enhancing argumentation tools based on a generic Learner Profile. Our approach concerns an alternative form of on-line learning with different forms of interaction, and a new way of promoting community building. Its purpose is to aid researchers and developers in the development of *personalized argumentation systems*, i.e. tools that adapt their structure and services to the individual user's characteristics and argumentation behaviour. Our main goal being to support individual and community learning, the proposed set of services is

based on personalized features and functionalities. We argue that it can further support learning, as well as the achievement of learning objectives, as it can assist CoP members in the development of learning skills such as the interaction with other actors, growth of their autonomy and self-direction. Nevertheless, in order to be creatively adapted in CoPs' everyday practices, the proposed services must fit into the specific culture, norms and incentive schemes of the community. Our future work directions concern the appropriate handling of these issues as well as the full development of the set of personalization services and its evaluation in diverse CoPs.

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