WED-BASED COMMUNITIES FOR LIFELONG MEDICAL LEARNING

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Abstract

The exponential growth of medical information, the increased demands for expertise and the limited time that people have to spend for self improvement, create the need for delivering the appropriate knowledge to the appropriate people in the minimum of time. Traditional learning and training approaches are inadequate to fulfill the needs of doctors and medical practitioners, who need to always get informed on new technologies, devices and products and seek for solution in specific problems. Open educational programs and e-learning solutions usually fail to adapt to the emerging needs. The only viable solution seems to be education on demand and communities offer good ground for this. This work examines web-based medical communities as a means for delivering education on demand whilst in the same time allowing participants to contribute their expertise. Successful community paradigms are reviewed and the structure of a community for medical learning is detailed. The community tools increase the synergy among industry, practitioners and scientists and allow information sharing, "on the spot" advices, and collaborative knowledge building. In the same time, patients receive valuable consults and industry disseminates information on new products and devices and promotes professional excellence. This work summarizes the benefits from the use of communities in deploying medical education to professionals and students, discusses best practices and pitfalls that should be avoided and gives a sketch of the community structure and tools to be employed.

1. INTRODUCTION

The aim of education is to provide the basis for life long learning and improvement. Universities offer standard curricula aiming to cover the fundamental needs of their students in a few years scope. On the other side, institutes and companies offer life long education in order to improve specific skills and competen-

cies in a short period of time. In a similar manner, medical education comes in two variations: a) medical studies offered by universities and schools of medicine, where students follow predefined curricula and receive support from their professors and other academics, b) life-long education of physicians, continuing training on their field of expertise and learning through reading and practicing.

Mainly in the second case, the aims, capabilities and availability of attendants vary significantly, since they usually have to cope with their morning work and their family duties. As a matter of fact, several issues, such as the limited duration of training programs, the loaded schedule of trainees, the inevitable absences due to other obligations, the multitude of topics to be covered, the variance of attendants' interests and needs, have to be considered in order to create a competitive training program that will fit everyone's needs.

Community approaches have several advantages that can be exploited in favor of medical doctors and students. Since a single institute is not always capable in coordinating such a composite effort, we capitalize on the building of a virtual community for education. The community should use all available tools in order to support attendance and inform people on the topics, requirements and aims of programs, in order to deliver information, training material, and support on demand, in a daily basis. The community will comprise training institutes, educators and trainees who will interact and co-operate in order to achieve maximum gain and flexibility.

The educational role of the community is strengthened in a multitude of ways: a) the use of asynchronous and many-to-many communication and collaboration tools, facilitates and increases the participation of members to the activities of the community, b) the dynamic role assignment to members, allows members to be educators and trainees in the same time, and increases members' awareness on the community activities, c) the content repository of the community is continuously enriched with new content such as reading material, assignments, self-assessment tests, members' communication logs etc. thus creating a common community knowledge, which can be valuable for future members.

In the following section, we refer to other works that attempt to offer education on a medical community. In section 3 we give an overview of the communication and knowledge management tools that can support the medical community. In section 4 we present the structure of the medical community. In section 5 we illustrate the expected merits of the suggested approach and discuss the issues that need special attention. Finally, in section 6 and present our conclusions and give our thoughts for future work.

2. Related work on medical education and the web

The aim of web based learning communities is to collaboratively improve knowledge in the field of expertise of the community. In the case of open learning

communities everyone is allowed to participate and either offer or consume the collective knowledge [15]. As a result, the members of a web based learning community vary from the non-experienced learner to the subject matter expert inside and outside of the community. The core activity of virtual learning communities is writing. People exchange messages with a shared goal of building understanding produce an information base which is available to future members of the community [13]. Learning is no longer a transmission of knowledge from a teacher to a student, but a process of knowledge construction in which each participant contributes and benefits from the ideas shared by the group. Useful knowledge sources comprise: questionnaires addressed to patients and their families, personal reflections of patients, discussion forum logs, virtual interviews of doctors and experts etc.

Virtual learning communities are emerging everyday in many health related domains. All these communities functioning today can be divided in four types of communities, classified by the intended members [22]. Virtual health care delivery teams, in which health care providers of different disciplines (such as physicians, nurses, social workers, physical therapists, etc.) create a team to combine their knowledge and expertise in order to provide a comprehensive plan of care [7]. An example is the virtual medical teams for the continuous treatment of home care patients, developed by Pitsillides et al. [23]. The second type of health care communities comprises the virtual research teams, where health care researchers and professionals employ new ICT technologies in order to communicate and exchange information. An example is The Virtual Radiopharmacy (VirRAD) [31] eLearning program. The third type of healthcare communities refers to virtual disease management, and aims at enhancing the care plan and the provider-patient relationship while emphasizing on the prevention of deterioration through the delivery of practical guidelines. An example is the home asthma telemonitoring (HAT) system presented in [11]. Finally, another category of virtual communities, comprises support groups, where people with interests gather "virtually" to share experiences, ask questions, or provide emotional support and self help [9]. As of April 2004 Yahoo! Groups listed at least 25.000 electronic support groups in health and wellness sections.

More and more, physicians browse web information in order to stay current in many areas of medicine. However, it is physically impossible to gather and absorb all the available data on research findings, new medications, and legislative changes affecting medicine. In order to facilitate the continuing learning process, several organizations have developed websites that collect, filter, organize and redistribute medical information [1]. These sites use a credit based system that enforces physicians to attend courses successfully.

 Another aim of learning communities is to replace Internet as an information source for patients [7]. A common scenario wants patients to spend hours in collecting information from the internet before visiting their doctors [9]. Such information can be misleading and confusing and is better to be filtered before visiting the doctor). Such filtering can be performed inside a learning community [20].

For example, MedConnect [17], which is affiliated with the HealthAtoZ Professional and the University of the Sciences in Philadelphia, offers text- and graphic-based case presentations, and several types of educational opportunities on primary care issues. Similarly MedScape's site [19] for continuing education (for professionals and patients) offers the ability to subscribe for monthly newsletters and alerts, to browse various medical education modules, to perform self assessment and gain credits or even receive an instant certificate. CME [6] is another source for continuing medical education, is owned by American Health Consultants and for a small fee offers a larger variety of CME courses than most Web pages.

An interesting community approach for providing education and support in rehabilitation issues is WheelchairNet [31], which has been developed in cyberspace by the University of Pittsburgh. As part of the community activities, the Wheelchair University offers academic and continuing education programs on rehabilitation and wheeled mobility areas. Research is a continuing and joint work of clinicians, manufactures, scientists, patients and transporters. However, the web site is the only means of virtual communication, which lacks of interactive services (i.e. forums).

Sermo [26] is another community approach, targeted to physicians. It works as a forum, allowing physicians to post observations and questions about clinical issues and hear other doctors' opinions. The closed nature of the site, has led some sources to refer to Sermo as a "MySpace for Physicians".

In a project developed at St George's, University of London, UK, named Clinical Skills Online (CSO) [4], online videos demonstrate core Clinical Skills common to a wide range of medical and health-based courses in Higher Education. The video courses are categorized by topic, by user's expertise and occupation and are available to the public. The option of user feedback is available through a questionnaire and a free text comments form.

What is obvious, from all the previous examples, is that an organization (i.e. university, hospital or company) is necessary for the coordination of the educational process, for the design of programs, modules and educational solutions and for the certification of the acquired knowledge. Life long medical education is currently delivered in the form of information updates, reading or viewing material in electronic format or traditionally in classrooms and laboratories. What is missing is the ability to identify students' needs and design custom solutions for them. What is also missing is a flexible environment that will allow communities to evolve, community members to help and get help on everyday issues [30] and at the end of the day to assess and certify their knowledge.

In order to build this environment, we suggest the full exploitation of virtual communities and their tools. In the following section, we present the architecture of a community for medical education and discuss the critical issues for a smooth and successful operation.

3   A virtual community for medical education

Virtual communities gather people with common interests and practices. Community members communicate regularly and for some duration in an organized way over the Internet using a common platform or set of tools [17]. In virtual learning communities, learning is the common interest, Internet is the carrier and network technologies are the supporting infrastructure. Anyone interested in learning is a potential member for the community, and is likely to communicate his/her opinion to other community members.

A review of the existing solutions in education reveals the power and flexibility of communities [22]. The undeniable gain from using communities in education springs from the increase in membership. Continuity is another important issue for any virtual community. From a technical point of view, continuous system maintenance is necessary for the stability of the community infrastructure. Moreover, a reputation system may help to elicit good behavior, encourage knowledge sharing among individuals and strengthen members' bonds to the community.

However, increased participation results in augmented administrational and operational costs and risks. Since the members carry all community tasks, the definition and assignment of roles, duties and rights to members is crucial. In opposition to virtual enterprises and organizations, the definition of rights and responsibilities in a community is not strict and changes according to members' need and participation.

3.1 Members

Potential members of a medical community for education are medical students, nurses and doctors that need medical training, trainers and tutors, researchers seeking to exchange knowledge, universities and institutes that offer training and companies that produce medical solutions and educational material on them.

Students or trainees are the building blocks of the community. They join the community in order to attend an educational program and obtain knowledge. They request for training and receive support and guidance by other community members or experts. Student-members should provide their educational profile in detail in order to be accepted. A pre-evaluation procedure will give educators a better view on members' knowledge and skills.

Universities and medical schools are the community motors. They assemble educational modules into classes and then targeted programs and guide students and trainees to improve skills. They undertake the administration of the community and in parallel monitor and facilitate members. They study the members' needs, design and offer courses and direct members to the appropriate knowledge. Individual educators and researchers are able to offer their expertise to the com-

munity, always under the administrators' control. The anatomy of a learning community is depicted in Figure 1 and explained in the following.
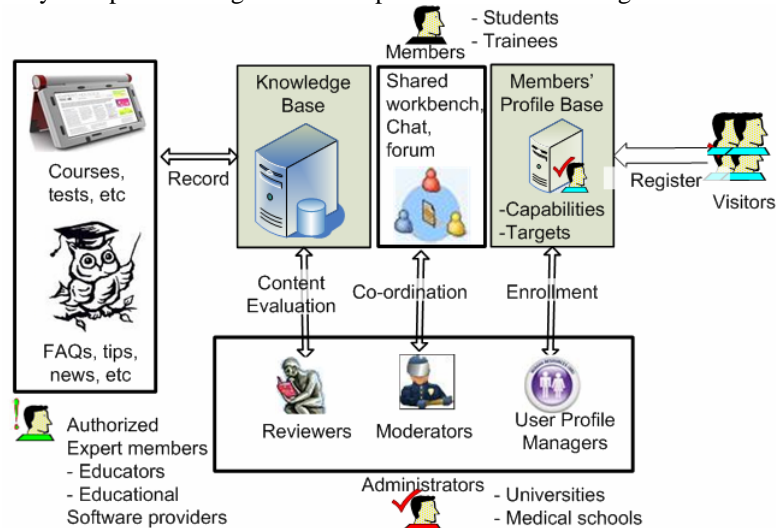

Fig. 1 A community for medical education.

In complement to the community members, several people, in the community background, guarantee the smooth operation of the community and the uninterrupted delivery of services. The IT staff that technically supports the community, the employees of the telecommunication services provider and the directors of the organization, company or hospital that hosts the virtual community are persons that do not actually participate in the community but play a key role in its secure operation.

3.2 Roles

Administrators and moderators are the two most important roles in any virtual community [3]. Administrators are selected from the educational institutions and are responsible for managing members' profiles and evaluating content. Tutors are assigned with the task of producing new educational material upon request. The same people carry out a moderator role in the community services. Additional material can be obtained from volunteers out of the community borders.

Apart from the educational subjects, community members need technical support on the use of the community services. The technical staff of the institutes will initially become the community facilitators [31]. However, regular community members with technical expertise can be accredited this role. The role tasks comprise the editing of help files or user manuals, the answering of frequently asked

questions and the response to members' requests for help. Facilitators will help new members, either students or tutors to get accustomed to the community services and take full advantage of them.

A hierarchical structure of roles, an accreditation and a reputation system will encourage members' participation and contribution [27]. Active and capable members of a community are promoted or assigned new roles. Members that do not contribute are restricted, demoted and set aside by other members.

3.3 Supportive structures

The building blocks of a virtual community are its members and an initial content. The collaboration of members, inside a secure and trustful community environment will increase content, will assist members' to ameliorate their profiles and will attract new community members. In order for the community to thrive, the harmonic cooperation of all members must be achieved.

The primary aim of members of the learning community is to improve skills and competencies. As a consequence, the community should consider the particular needs and targets of life long learners [13], which in the case of medical communities comprise among others: medical theory, nursing theory, management, patient psychology, health regulation, prevention, emergency handling, trauma management, rehabilitation etc. The community should be able to adapt content and courses at any time, in order to capture changes in the work environment and follow the rapid technological advances. A profile base where members' skills, needs and educational targets are recorded is very useful in the design of new courses or seminars. The analysis of members' profiles will give better educational solutions and create competitive groups of learners.

A "knowledge base" [25] will contain educational material organized by topic, course scenarios, educational solutions, program evaluation reports, answers to users' requests etc. Additionally, it should offer self-assessment solutions to trainees and exam scenarios that will lead to certification. The educational content will be enriched during the community lifecycle, with new study material, tests and activities. Educational programs must comprise reusable learning objects that can be easily recomposed or transformed to fit individual needs. The use of learning objects facilitates the monitoring of content, since it is easier for institutions to rate the quality and suitability of content uploaded by educators. Additional training material can be added by authorized members, only after evaluation.

The success of a health-related virtual community is based on the frequency and quality of members' contribution. A trust management mechanism [15] that keeps record of the members' reputation inside the community and continuously updates it by analyzing other members' feedback can be useful for encouraging members' contribution and increasing members' awareness on faulty consultation and fraud. The reputation management module, will gather members' opinions on

other members, will process data and provide each user *x* with a reputation score for any other community member *y*. This score will be based on the community reputation for this member *y* (what others think of *y*) and the direct trust towards this member (what *x* thinks of *y*). This mechanism will encourage members' contribution to the community and in the same time will discourage malicious behavior since it will lead to decrease of trust.

In addition to the members' reputation mechanism and the content evaluation process, the community must develop a mechanism that acquires and processes user-feedback on the educational process as a whole. User polls, complaint forms, and user-feedback forums will facilitate community designers to locate the platform errors and the points where the educational process can be improved.

Finally, the power of the community resides in the ability of members to collaborate. It is essential in this case to build a collaboration environment and encourage members' interaction through group activities. In such activities, distant members of a virtual class are forced to communicate, to participate in synchronous activities, to split composite activities into tasks and work in subgroups etc.

In the following section, we present how the available community tools can be combined in favor of the medical community.

4. A prototype community structure

4.1 Services

The community must build a gateway for people or companies outside its borders that wish to cooperate with the community. Information services are the front-end of a community. A web site with informative material on the community activities, sample courses, contact information and a feedback form will allow companies or individuals to offer content and potential students to reach and join the community. The community site should be simple and provide support to the community members. This can be established by providing informative material to members (online tutorials, manuals, frequent questions and answers etc.) and by assigning guidance roles to selected existing members (facilitators, moderators etc.).

Communication services (synchronous or not, private or public) are vital to all community members: to educators for coordinating their collaborators, guiding and supporting their students, to students for discussing about assignments and requesting help on activities.

Collaboration services are very useful when they are coupled with educational activities. A group project turns autonomous learning into a collective activity and helps students to improve their analytical and collaboration skills.

4.2 The assembly of web and web 2.0 tools

The nucleus of the virtual community should be equally accessible to members and visitors.

A web site is necessary to welcome web visitors and guide potential members into joining the community. The site should provide informative content on the community aim and structure and can be created as a joint effort of the universities or educational institutes that support the community. The web site will advertise the educational programs and will provide information concerning every day activities of each course, news and announcements of interest to the students.

The web site administration should be performed by technical staff from the educational partners of the community (i.e. the university). Coordination tasks will be held by the registrar office that will be responsible for the members' accounts, their participation in virtual classes etc.

A smart and cost free solution for the website is presented in [29]. There, the web site was a blog, created by the university. The blog was visible to anyone, but practically only registered community members were allowed to update content or comment. In an effort to delegate administration tasks, a "weblog umbrella" was created (see Figure 2).

Blogs (or web logs) are easily updatable websites where administrators can post messages by filling a few forms and without special knowledge on web design technologies. Separate blogs for each course allow course tutors to better organize their courses, to add or drop material, to add short notices or announcements and manage the comments or posts of the community members. The students were permitted to comment on the tutor notices thus providing them with useful feedback. Weblog visitors were able only to read announcement or comments. On the top of this set of weblogs we created an additional weblog for the whole program, in which community members were able to post messages. The program web log was accessible for the program web-page and provided links to all program courses.
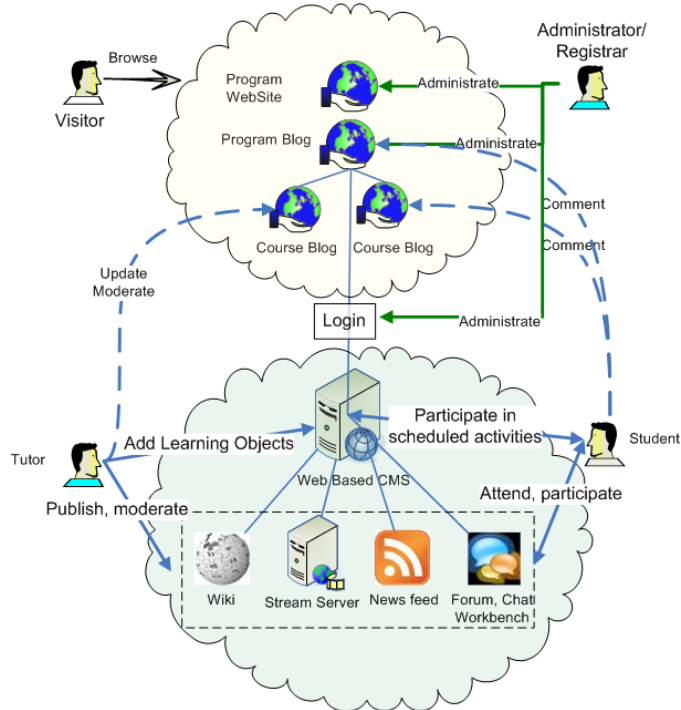
Fig. 2 The blogs on top of the community

Below this umbrella that provides general information on the program, lies the main educational activities of the community. These activities can be ideally supported by a web based course management system (i.e. Moodle, eFront, Claroline, Blackboard, ATutor etc). Such systems are specialized in managing and delivering on line courses, and assemble various community tools such as forums, wikis etc.

In the majority of courses tutors use the community application solely for provided reading material to students. However, in several cases, students and professors need the forum, chat and other services in order to coordinate their actions. When an integrated course management system is not available, the community can be still operational by combining various open source tools.

Computer-mediated chat, discussion forums and newsgroups can be formed and supported by the community administrators. Such forums will host discussions focused on the class learning goals [3] and will be used from tutors for guiding their students. Mailing lists and web feeds can be in assistance of the tutor for the coordination of a course. For example the tutor will be able to inform students on an upcoming examination or assignment.

When there is need for building collaborative knowledge and making it available to medical students and practitioners, wikis are a cost free open source solution. A wiki is the collaborative coverage of a topic from the members of a com-

munity. Any member can contribute or modify the content under conditions (proper reason, provide references etc.). The vast number of medical wikis currently available [18] is an indication of their popularity and their importance for medical matters. A wiki can be created and moderated by the domain experts in order to quickly build a terminology source for students.

Other collaboration services comprise, virtual workbenches, virtual blackboard etc. The results and history of collaboration services are usually stored and used as a reference by other community members. Such applications usually require specialized software and dedicated sources and thus are not widely used for medical education. The educational potential of virtual worlds has attracted the interest of medical communities, and created new opportunities for medical education in the cyberspace [2], [26].

When a teleconference room is available, distant courses can be performed from the joint institutes. Tutors and students communicate using real-time video over a streamed media server. Educational multimedia content (i.e. medical videos from surgeries, recorder sessions or courses etc.) can be stored in media repositories, and made available to community members. Free video hosting servers can be used for this task, however, bandwidth and storage limitations, restricted access and other issues should be considered.

The applications presented in the bottom section of figure 2, can be accessible both to students and tutors, however the degree of participation increases for students as moving from left to the right. All these services (i.e. wikis, streaming media, news feed, forum, chat, workbench etc.) can be offered through separate tools and platforms or ideally through the same Web Based CMS.

The next section illustrates the gains for individuals, companies, organizations and biomedical science in general.

5. Expected results from the community approach

The educational role of the medical learning community is jointly supported by more than one community services and structures. According to [4], the educational solutions that can be offered by the educational community comprise autonomous courses, complete course series, complete programs, standalone teaching or teaching associate with study material, training programs targeted to special groups of trainees, programs that lead to certification, etc. In a medical learning community, members chose any of the above solutions and employ one or more of the following learning methods in order to achieve their common aims: they study the related educational material, attend seminars and lectures, examine related clinical case studies and participate on medical meetings.

The following table presents how the aforementioned learning methods are supported by the community services and structures:

	Study theory	Attend seminars	Examine cases	Medical meetings
Knowledge base	Study material	Online seminars, audiovisual content	Clinical case databases	Minutes of meetings are added to the repository
Collaboration tools	Collaboratively collect reading sources (in a wiki)		Simulation environments	Synchronous and asynchronous services, telemedicine
Communication services		User feedback and online questions		Teleconferencing

Table 1. Learning methods and community services

A side role of communities apart from the education of doctors and students is the increase of synergy between companies, experts and clients. Doctors can join the community and share their knowledge with other colleagues. Communities also support the exchange of empirical knowledge which is more focused to patients' and doctors' needs than theoretical knowledge. Participation in forums allows patients to ask questions and doctors and engineers to increase the consultation time. Finally, when communities are open to the industry, they can receive information on new products and devices thus promoting professional excellence of engineers. The result is that community members will work smarter that harder, will communicate expertise to the new members and acquire maximum benefits. The benefits from the use of communities are the main motive behind the participation.

The benefits for practitioners range from the alleviation of their everyday tasks to the development of their skills and professional profile. Professionals share their knowledge voluntarily with other members, invite new members and contribute on the expansion and guidance of the community. Active personal contributions to the community is a long-term investment and leads to recognition (awards, fellowships). Through the community, doctors and nurses can be informed and trained on tools and techniques of their field of expertise. Training can be delivered by specialized institutes and lead to professional certifications. The community can be a vault to their career, as new job opportunities emerge from the professional network. The ability to remotely collaborate with other community members increases job flexibility (contingent workers, free-lancers etc.)

The benefits for the medical industry are mostly organizational and strategic. Firms have the ability to define key knowledge areas, and cover their needs for expertise by directly contacting doctors through the community. They can also define the strategic resources and the core competencies of medical industry and tar-

get research to this direction. Organizational restructuring allows companies to expand their borders and to better organize and monitor the production lifecycle. They are able advertise their products easier and with minimum cost and increase their potential markets.

The gains for research institutes, universities and scientific organizations comprise: interaction with industry and consequently applied research, increase of basic research through the collaboration of researchers world-wide. Universities can act as focal points of the community of practice, by providing support and guidance to enterprises and education and training to engineers. Moreover, through the co-operation with industry, research increases funding and gains access to empirical data.

6. Conclusions and future work

The gains from the use of virtual learning community are many for universities, students and professionals. Students exchange empirical knowledge and carry out learning activities. Tutors increase their consultation time and contribute to the guidance of members more easily.

The benefits from the use of communities are the main motive behind the participation. The benefits for the educational institutes are mostly organizational and strategic.

It is in our next plans to increase the activities of our community and create new educational scenarios that fully exploit the community infrastructure. We already setup a community using open source tools and software and we intend to analyze the users' behavior inside the community in order to detect what is attractive and what is not for the students, what possible flaws in courses result in decreased participation. Finally, it is our aim to design an evaluation framework, which will be used to assess the usability of the provided services and interfaces and to judge on the educational value of the community approach in medical education.

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