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APPLYING LESSONS LEARNED IN DISTANCE EDUCATION TO TELEHEALTH

M. Stella Atkins, F. Belli, School of Computing Science, SFU, Canada
M. Kouadio, R.N. McTavish, Centre for Online and Distance Education, SFU, Canada
{stella@cs.sfu.ca , fbellich@cs.sfu.ca, mkouadio@sfu.ca, rob.mctavish@gmail.com}

ABSTRACT

Both DE and telehealth systems provide remote access to services, supported by digital technology infrastructure. Both systems aim to enhance the quality of service for remote communities that may otherwise not have access to expert knowledge or support. Unlike DE, which has been employing technology to support and teach students remotely for some time, telehealth is relatively new, with no standard technological tools. This paper describes opportunities for re-use of IT systems employed in DE into telehealth applications, where the "student" and "educator" in the DE domain may be replaced by the "patient" and "remote health care provider" respectively in the telehealth domain. We consider similarities and differences between the requirements of patients vs. students, and the requirements of the remote health care provider vs. the educator. This investigation into the similarities of DE and telehealth exposes potential for the exploitation of DE systems and expertise that already exists and is readily available. Such resources may speed the employment of such technological tools for supporting patients remotely, increasing the options available for both health care professionals and patients.

KEY WORDS: distance education, telehealth, IT infrastructure

1. Introduction

Distance Education (DE) has been practiced for many years, and is now relatively mature, employing sophisticated software with standards already developed [1-4]. In contrast, telehealth is relatively new, with no standard software. We are interested in possibilities for re-using software from DE systems into telehealth applications, where the "student" in the DE domain may be replaced by the "patient". Similarly, the "educator" may be replaced by the "remote health care provider" in the telehealth domain. In this paper we consider similarities and differences between the requirements of information technology (IT) support for both DE and for telehealth applications, and suggest how some DE software may be reused for telehealth.

2. Similarities between DE and telehealth infrastructure and software requirements

2.1 Network QoS (Quality of Service)

Like the first DE systems, the implementation of telehealth systems is primarily driven by the need to improve access to services, and to reduce the cost of delivering existing services. This is especially true for health care organizations that serve large geographical areas composed of small remote communities where access to health care services is limited [5]. Delivery of telehealth services in most of these communities faces the same challenges as for the delivery of DE services. One of the most pressing challenges is low bandwidth connections. This problem is not as acute as it was a decade ago but it is still an issue that dictates in many cases what can be done, how, and when. In recent years a higher demand for high speed connections to the Internet and government policies have resulted in more remote communities having access to high speed links using broadband technologies [6]. Furthermore, new quality of service aware transmission protocols such as RSVP or DiffServ that guarantee bounds on delay and bandwidth availability are being deployed on top of IP (the Internet Protocol). In addition, many rural communities and developing countries are embracing wireless networking at a sustained pace, which combined with satellite communication could significantly improve data transmission capabilities. If this trend continues, the technical issues related to low bandwidth connections will be solved in a few more years but the cost associated with using the communication channels will always be present and in some ways continue to dictate what can or cannot be done. In addition; in the past few years we have seen the concept of what is considered a fast connection change due to the ever increasing demand for speed that new technologies and systems place in communication networks. Not even recognized organizations can agree in what bandwidth is considered "fast" [7]. This is a constant reminder that the bandwidth issue is probably here to stay and both DE and telehealth systems will continue to deal with it in one way or another in the foreseeable future.

The ubiquity of the web provides the necessary basic infrastructure for low bandwidth applications such as email, asynchronous conferencing and information/

resource sharing and research, tasks that are shared between both telehealth and DE users. Users of both systems can rely on basic services deliverable over low bandwidth solutions; however high demand applications such as video and audio conferencing are still unreliable and inconsistently available.

2.2 Need for 1:1 interaction

For many years Distance Educators have been delivering high quality material that relies on considerable interaction [1, 8]; models which telehealth users can easily adapt to have access to resources and support. The need for one to one interaction is a common requirement in both DE and telehealth. DE requires a way to provide 1:1 communication between a professor and a student or between a pair of students when needed. In telehealth the need is even greater since in most cases a health care provider and a patient are the only ones who interact in a session. Even though the requirements are a little different because of the differences in the way the services are delivered, DE is the best source of information about what has worked and what has not. If DE users were not keen, or they were concerned using a particular technique or tool, likely the same will happen with telehealth users.

2.3 Group Learning Models

With the advent of the web and the ease of implementing both synchronous and asynchronous online discussions, distance educators have moved towards the development of courses based in the constructivist pedagogy [9-11]. Social constructivism suggests that learning is an ongoing process involving the social construction of knowledge through interaction such as dialogue and online discussions [12]. An unexpected outcome of online discussions that has recently become a *tenant* of online course delivery is the support and socialization that takes place. The instructor can utilize the breadth of knowledge brought to the course by the students to assist each other in solving both curricular and personal problems. Within a telehealth context, socialization and support provided by more "expert" patients can assist in providing information and comfort to "novice" patients, thus potentially reducing workload of healthcare professionals. However, note that building space for communication and implementing a system does not guarantee the system will either work or be used. Scaffolding and support, as well as ensuring users feel safe to interact, is crucial for success.

Failure to integrate into a community typically leads to alienation and eventually withdrawal [13]. Tinto [13] states "experiences that promote students' social and intellectual integration into the communities of the college are likely to strengthen their commitment and therefore reinforce persistence" (p. 35). This supports Astin's [14, 15] theory, which states students need to be active participants in their education, and that without such active participation there is little connection or investment to their institution, and without such commitment withdrawal is therefore easier. Patients who are members of an online community would benefit most from active, frequent participation, in the same manner in which students are more likely to succeed [13, 15]. In an academic setting the allocation of grades can be an incentive for such participation, however in a telehealth setting the patient must recognize some benefit to participating.

2.4 Need for Privacy and Security

DE and telehealth systems share almost the same concerns and requirements in the area of privacy and security. Both are required to maintain personal information, records, and any direct communication, secure and private. While in DE there is not an expectation that every communication will be done over an encrypted channel, there is the expectation that the systems in use have different level of security that can prevent their unauthorized use and to properly safeguard any information exchange or information posted in the systems. Telehealth systems are required to have the same or even higher security standards than DE due to the sensitive and confidential nature of the information exchange between a provider and the patient. Most patients expect that some or all of the information that they share with their providers is kept confidential by them and any records maintain about them be kept secure and private [16]. In addition, it is recommended and required in many countries that any Health Information System has the capability to monitor and log when an electronic record was accessed and by whom [17]. To address the security issues and network quality of service required for appropriate telehealth applications, many healthcare providers tend to avoid altogether the public Internet and use dedicated networks with more stringent access requirements and guaranteed service level agreements among their facilities or their peers. Interestingly, these networks provide a great opportunity to deploy resource intensive multimedia applications such as those used in DE.

For online forums to succeed it is necessary to provide a safe and secure environment where users can participate without fearing negative consequences [18]. Building trust takes time and effort and can quickly be lost when a user behaves inappropriately. Within an educational context users are always identifiable and know the consequences of violating protocols for online interaction. In a telehealth environment users may or may not be anonymous and there are little real consequences for poor behaviour, other than social isolation. Having a moderator monitor the discussion forum and either approve of messages before they are public, or remove inappropriate messages helps ensure a productive and supportive environment. However it can be arduous and time consuming and create dilemmas between enabling users to freely express themselves while trying not to alienate or offend other users [19].

2.5 Training and Ease of Use

The success of online distance education can be partly attributed to the integration of common technologies that are either familiar, or require minimal training. As students' skills develop and confidence increases, new technologies can be introduced, such as synchronous technologies which enable desktop sharing, whiteboard applications, and audio/video conferencing. Telehealth applications of technology could benefit from a suite of tools that allow users to self select based on their competencies and support structures. In many situations asynchronous communication would suffice for the social support or education of a patient. In other situations full synchronous communication and the transmission of health data would enable a patient to remain at home and be remotely monitored. Such critical data and the requirement for continuous, non-interrupted communication is not required in an educational setting, however some tools could be effectively deployed, such as a desktop sharing application. The patient, the family, and the medical professionals would need to develop a care plan that ensures the needs of both the medical system and patient are met. Issues such as the risk of communication loss versus the comfort and cost of being at home would need to be identified and discussed.

2.6 Provide quality course material

Quality education depends on accurate and reliable course material developed by educators and made available in an easy to use format to students. The educator may then control a gradual release of the material to students as they reach different milestones in their study progress. The beauty of this DE system applied to telehealth is the opportunity for providers to develop a reliably comprehensive library of online healthcare knowledge whose delivery mode may be automated to fit a patient background and progress, since preventative and clinical care involve a substantial amount of patient education. Such material may be organized and structured with DE systems such as Moodle that are built upon sound underlying pedagogical principles and integrate features such as glossary of terms.

2.7 Provide opportunities for collaboration

DE systems have been conducive in bringing about communities of practice between teachers who can thus easily learn from each other. An interesting example is a course in Canadian Studies that ran simultaneously at Simon Fraser University, the University of Manitoba, and the University of Saskatchewan through WebCT. Participating students and teachers from these three institutions could seamlessly reflect on different aspects of the make-up of Canada and issues Canadians face today. This could be adapted to telehealth where health providers would find a dynamically structured collaborative environment to monitor patients, discuss technical topics, seek and share opinions and reinforce their professional development. Furthermore, as in the above described educational experiment, health providers would be able to share the workload of the activities involved: knowledge base development, revolving special office hours to allow patients to drop in the virtual classroom (clinic) and discuss issues of interests, etc.

3. Differences between DE and telehealth infrastructure and software

3.1 Need for more infrastructure reliability in telehealth

One main difference between DE and telehealth is infrastructure reliability. Telehealth applications require that the system be available when needed, especially for those applications that involve patient monitoring, diagnosis, or any other procedure or task that could compromise the wellbeing of the patient. Special care must be taken to assure that when it is not possible to warranty the totally availability of the system through a redundant or backup infrastructure, alternative procedures are in place to properly deal with foreseen and unforeseen situations. This can be as simple as describing the process to reschedule an appointment using manual procedures and protocols, to more difficult situations to assure patient safety in case of inability to monitor a patient remotely. This does not imply that DE applications do not required a reliable infrastructure, but rather the level of redundancy required is lower due to their non-critical nature. A student can miss a DE class but missing data collected remotely from a patient might have serious consequences to the patient health or in the case of telesurgery can even be fatal [20].

Typical distance students' online interaction lacks the critical nature of requiring a fail-proof network or other redundant technologies to be in place such as cellular or satellite telephone alternatives. Telehealth applications may require such redundancies, yet they are expensive and not always available. Some redundant services also rely on shared power or telecommunication links which negate any reliability for critical connectivity. Finding a balance between the flexibility of being remote and the need for health care providers to have access to information needs to be assessed, potentially limiting some patients from remote access. However recent advances in telecommunications have enabled more distant students to have access to distance education opportunities, and similarly patients should soon also benefit.

3.2 Need for synchronous communication in telehealth

In DE the interaction may not necessarily be synchronous: students enrolled in distance education classes typically participate asynchronously, removing the time barrier that often excludes them from their ability to actively participate in a learning environment. However, synchronous and real-time communication must be part of almost any telehealth application

especially those involving diagnoses, treatment, or follow-ups. Patients expect to have a real time conversation with their health care providers. Email or other kind of asynchronous communication used in DE can be used in telehealth systems, but only as a secondary communication tool. Not only can asynchronous communications end up being irritating and frustrating to the provider and/or the patient due to delays in the responses, but also add to the workload of already busy health care workforce. It is worthy to notice that even synchronous communication, like videoconferencing, can be rejected by patients if the quality of the communication does not meet minimum standards. In practice, ordinary videoconferencing requires about 384 Kbps with some margin of tolerance below that threshold, while telemedicine may require as much as 700 Kbps to carry the appropriate level of details in some cases. It has also been observed that the degree of tolerance to less than optimal communication is influenced by the patient's condition [21].

3.3 Need for clinical care in telehealth

One of the major differences between educators' role in DE and that of providers' in telehealth lies in the clinical care that the latter performs. In DE, educators may never be in physical contact with students and the education is delivered with the expectation that students will be able to perform all required learning activities by themselves. Telehealth not only encompasses most of the educational activities of DE, but also includes telemedicine that focuses on the clinical, curative medical care that may even require that a doctor performs a remote operation. Such operations often involve the physical presence of nurse or paramedics at the patient's location, which goes beyond the role of the educator in DE. Telemedicine may even use tools from robotics for real-time remote medical procedures [20], an activity which currently is not yet well integrated to DE.

3.4 Need for course management features in DE

It is important to notice that many of the course management features that are available in DE systems are not applicable to telehealth systems, like the need to have sophisticated grading and marking schemes or the delivery of scheduled activities or lectures. Also group activities are considered a very important part of DE since it encourages learning from peers [1](50% of the learning is done in this form) whereas telehealth, where applicable, would likely involve only small focus groups for support and learning.

3.5 Access to health records for telehealth

Data on students is rarely needed, other than their contact information, while access to health records can be critical to a patient's health. More importantly, relevant patient records may be spread out in clinics under different authorities and may require a real-time consolidation. Ensuring a system that maintains privacy and security, while affording flexibility to access is necessary for telehealth success. Students can provide information to instructors that can later be verified with little risk. However, patients aren't always in a position to provide information, and incorrect information can be potentially fatal. Simple technologies that are portable such as USB Flash drives which log data, could be used as transportable data and stay with the patient at all times.

4. Similarities and differences between students and patients

4.1 User profiles

The user profile in telehealth is quite different than in DE. Most DE students are literate, technology savvy, or at least inclined to spend time learning what it is needed in order to properly interact with the DE applications. By contrast telehealth users are patients that in many cases did not have the option to choose the way that a particular health care service is delivered to them. They come from all possible backgrounds, from very literate people to totally illiterate, from technology savvy to technologically challenged, and from kids to adults [22]. In addition telehealth users, especially the very elderly or handicapped, face the additional challenge to interact with a system that they might not be able to properly control or use due to physical or mental limitations. Special consideration must be taken to assure that telehealth applications are designed to be simple, friendly, and adaptable so they can be used by different groups of people with different level of mobility and mental capacity. These particular challenges do not exist in DE due to the fact that most DE users have to fulfill prerequisites and be willing to learn how to use the system: it is not only part of their courses but also part of what they agreed to when signed to take them.

4.2 User-friendly interfaces

Supporting students effectively and efficiently is crucial for learning, however providing support to patients is critical and without proper support can lead to tragic results. A goal of providing educational opportunities online has been to select technologies that were as transparent as possible, tools that users either already had experience using, or were somewhat familiar with. Few technologies have been designed solely for the delivery of education, rather, technologies have been adapted for teaching and learning. Email, Web, video and audio conferencing are examples of technologies being used effectively to support students in learning that could also be used in telehealth to support communication between patients, and patient to clinic or health care worker. As patients don't always select when they require medical attention, support and training may be an issue, therefore using ubiquitous, low tech solutions (intuitive and usable solutions) such as email and the web may be effective tools to support

communication, similar to the manner in which students are supported in a distance learning environment.

4.3 Safety and Relevance of information

Providing a tool in which users are able to communicate and share experiences can be beneficial in building community, however it is also important that correct information is being shared and distributed. Within a learning environment the damage of misinformation has a relatively low impact, but in a telehealth environment such misinformation can be hazardous since some users might act on it after reading it. Fox and Rainie [23] found that 72% of users gathering health information from the Internet believe all or most of the information they found online, especially if it matches what they previously found in other web sites. They also found that 73% of users at some point rejected the information they found. Some of the main reasons given for the rejections were: they couldn't determine the source of the information (42%) and/or they couldn't determine if the information was current (37%). These findings not only emphasize the need to educate and train users to be critical in their reading but also to provide them with the necessary information that allows them to validate and judge any information that is presented to them.

Quality of the information provided in any telehealth application must be guaranteed in order to assure the safety of the patient using it. In recent years, many ethical codes (HONCode, eHealth Code of Ethics, HI-Ethics Code of Conduct) and guidelines (HSWG Quality Criteria, Silberg's Quality Criteria) have been developed to guide and inform health care professional and organizations in the proper way to post health information in order to assure its quality and provide users with the facts they need to corroborate it [24-26]. For example, in the Silberg's Quality Criteria four main references must be given for any health information published online: authorship (authors and their contributors with affiliations and credentials), attribution (references and sources for all content), disclosure (publisher ownership, sponsorship, and potential conflicts of interest), and currency (date of the first posting and dates of any subsequent updates) [24]. In addition, in those cases where medical advice is given online, proper information must be provided about the competence of the person giving the advice and the mechanisms to verify his/her credentials. This information and any disclaimers must be displayed in a way that ensures users notice it and hopefully read it.

Within both a telehealth and DE environment, users require training in how to be critical in their reading: they should always question the source and validity of any posted information. Without guidance or training both students and patients may be at risk. As mentioned earlier, moderating all discussion, synchronous or asynchronous is seldom possible and too onerous a task, particularly with health care professionals who are already overworked. Training patients how to be critical of information and how to effectively communicate and share information online is necessary to have a productive online community [27]. DE students receive orientation on both the technology used and on the skills necessary to critically evaluate online information and resources; providing such training for patients would also be necessary.

4.4 Self assessment tools

Distance Education systems provide self-assessment and review tools that allow students to determine their progress and exercise a greater control on the pace of their study. They also include options for students to record their learning life events and stories, (commonly known as blogs). Activities like these may be easily adapted to telehealth to get patients more involved in the understanding of their health issues.

5. Summary of Roles and Activities in DE and Telehealth

Similarities and Difference between DE and TH	
Distance Education	**Telehealth**
Instructor delivers course to remote students	Provider delivers healthcare to remote patients
Tools are commonly available for Internet delivery	Active research in new tools, but not widespread adoption as DE
Students generally technology literate, in good health and typically do not require instructor physical presence at their location	Patients may require accessible tools and the physical presence of assistants (e.g. nurse, paramedic) to perform medical procedures
Typical network QoS requirements within DSL or Cable	Network QoS requirements may be more stringent for some applications
Typically soft real-time multimedia applications	Most current applications are soft-real time; but may involve mission critical hard real-time

6. Conclusion and future work

In DE, educators seek to educate students who are unable to come to a classroom for a face-to-face learning interaction. Educators may run group or one-on-one sessions with students using interactive text messages, audio or video. Health providers share the same role in a great many telehealth activities such as tele-consultation, remote monitoring, teletriage, tele-advising and follow-up. Health providers may also work in collaboration with an aide such as a nurse, an activity similar to Tutor Marker/Teaching Assistant in DE.

We have shown that DE systems have many similarities with telehealth systems, and that the health community should be able to use and exploit the experiences gained from the DE community in designing telehealth software. In particular, the interfaces for aspects of synchronous 1:1 communication, and the potential for group learning should be exploited in telehealth systems.

Our future plans involve running a pilot project with healthcare researchers to assess the ease of reusing DE software for telehealth applications, and the effectiveness of the resulting system.

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