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Going beyond your Personal Learning Network, Using Recommendations and Trust through a Multimedia Question-Answering Service for Decision-support: A Case Study in the Healthcare

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Abstract: Social learning networks enable the sharing, transfer and enhancement of knowledge in the workplace that builds the ground to exchange informal learning practices. In this work, three healthcare networks are studied in order to understand how to enable the building, maintaining and activation of new contacts at work and the exchange of knowledge between them. By paying close attention to the needs of the practitioners, we aimed to understand how personal and social learning could be supported by technological services exploiting social networks and the respective traces reflected in the semantics. This paper presents a case study

reporting on the results of two co-design sessions and elicits requirements showing the importance of scaffolding strategies in personal and shared learning networks. Besides, the significance of these strategies to aggregate trust among peers when sharing resources and decision-support when exchanging questions and answers. The outcome is a set of design criteria to be used for further technical development for a social semantic question and answer tool. We conclude with the lessons learned and future work.

Keywords: Semantic Networks, Question-answering systems, Decision support
Categories: I.2.4, H.3.4, H.4.2

1 Introduction

Kraker [2013] identifies the need for interdisciplinary teamwork across domains. This raises two issues, the first being the challenges resulting in working places where different professions have to communicate and exchange learning effectively, joining their forces. The second is the isolation that can occur when these interdisciplinary teams have representatives of the same profession and the need arises to facilitate the communication of these distributed professionals, too. A major factor in these both kinds of exchange (i.e. communication within and beyond a single discipline) is trust as elementary basis and enabler of relationships in the professional domain. Hence, this paper focus its attention on trust building issues through the design and development of a Social Semantic Question and Answer (Q&A) service improving interactions among professionals and providing extra support to help with the knowledge sharing.

Studying, analysing and understanding how social network technologies scale personal interactions of healthcare professionals by extending and augmenting the reach of their learning networks lays the ground for designing and developing the Q&A tool. For us, scaling personal interactions represents scaffolding professionals as they develop, maintain, activate and move from their local trusted Personal Learning Networks into wider networks in order to expand their knowledge. In our first year studies (2013), we investigated individual learning and knowledge sharing, and created a variety of design artefacts including user stories, process models, personas, paper prototypes and wireframes [Thalmann, 13; Santos, 14]. The results extracted from the first year studies showed how the exchange of questions and answers is an important practice in this professional context, but this practice tends to occur in little groups of practitioners (details below). The main issue is that the learning resulted from these discussions is lost for the majority of professionals and similar peers with similar problems in the same organization cannot take benefit of it. For this reason, our aim in this case study is to understand how to enhance the practice of seeking help in the healthcare workplace by supporting trusted interactions.

This paper presents a case study and analysis carried out in a real healthcare environment and its respective insights to develop a proof-of-concept of Q&A tool. The richness and depth of the information coming from our healthcare professionals is significant in terms of current UK health agendas; scaling of technology casts new insights into how and where informal learning occurs in their workplaces. This study explores how the exchange of question/answers in a professional learning network

can be used to support trust and decision in healthcare. The empirical results are used to propose a list of design criteria with the aim of implementing a Q&A service for the healthcare. The Q&A service will be part of the Social Semantic Server (SSS) [Kowald, 13; Dennerlein, 15]. The SSS aims to provide such services, and deals with relations between actors, artefacts and metadata. Building up the networks based on the usage of particular services (e.g. tagging), enables the exploitation of emerging social information for other services such as recommendations, which potentially can be used for decision-support (e.g. connect with new peers, solve my problem by finding similar question/answers). In order to reach these objectives, conceptual and technical researchers have been engaged in a co-design process together with healthcare professionals to uncover ideas about learning, performance, behaviour and cognition as part of the inquiry process [McKenney, 13] . This tool and the studies presented in this paper form part of the four year project Learning Layers (LL) funded by the European Union's Framework Program 7. One of the main aims of LL is to develop technologies and services to support informal learning at the workplace that will enable situated and contextualized learning.

The paper is structured as follows: the background and motivation for the study is presented; followed by the case study accounts reporting on workshops; we outline the health network professionals involved – nurses, practice managers and data quality analysts. We conclude by using the main results from the workshops to identify a set of design criteria defined to implement the Q&A service.

2 Background and relevant literature

In this section, we aim to understand how existing approaches can be combined with the results from our co-design sessions to build the Q&A service.

2.1 Social Learning at the workplace

Wenger depicts the success of an organization as its ability to enable individuals to design their own social learning systems [Wenger, 00]. Examples of informal learning at work are: going to a conference, meeting 'external' peers, having deepening conversations with colleagues or exchange question/answers and opinions. This experience is then shared with work peers, and the knowledge starts to 'change' the community. This supports Wengers definition of learning as the 'interplay between social competence and personal experience'. Previous studies [García-Peñalvo, 13] show the benefits of supporting the social aspects of informal learning, and the personal aspects focused on the individual learning experience by making possible the tagging, recognition and acknowledge of learners informal learning activities. In particular, our aim is to enhance the practice of help seeking by improving the engagement in questioning and answering in a professional healthcare environment. Hart and Jarche, identify a set of key features demonstrating the attraction of learning in a 'community' [Hart, 14]. The five main features are: (1) online learning has to be 'Integrated' in the flow of work. Second (2), learning (i.e. exchange of question and answers (Q&A) has to be 'Continuous' and come from internal and external channels. (3) 'On demand', find answers to the problems when needed. (4) 'Social', learn from and with other peers. And finally, (5) 'Autonomous', professionals like to be self-

directed, self-organized and self-managed, and have control over their learning. These key features have guided our co-design sessions.

2.2 Aggregated Trust in Personal and Shared Learning Networks

For Victor, Cornelis, & De Cock, trust networks are those ones where people augment their connections by interacting information shared in the network and building trust [Victor, 11]. Thereby, our assumption is that online users tend to look for trustworthiness and expertise clues to establish a level of credibility of resources, people and topics for informal learning. In regard to trustworthiness, Jessen and Anker propose in [Jessen, 11] that a certain piece of information (and/or person) is perceived as credible when the following factors are combined: (1) Social Validation: a high number of people acknowledge a certain piece of information as trustworthy; (2) Personal profile: the members of the network provide an identity online; (3) Authority and trustee: a source of information is supported by an authority on the matter or trusted members. In their view, multiple streams of trustworthiness clues form an aggregate of perceived credibility that determines dynamic of aggregated trustworthiness. With respect to expertise, Manca and Ranieri propose in [Manca, 13] that personal data, online social context and online interactions are the main types of information to characterize the "expertise" of individuals in social networking sites. As the authors claim, at the moment, there are no automatic or semi-automatic measures to communicate 'trust', which represents one of our goals.

Crucial to our analysis of aggregated trust is to understand the difference (if any) between Personal Learning Networks (PLN) and Shared Learning Networks (SLN). The following questions arise: What inferences has the use of tagging on SLN? What is different in SLN with respect to trust? In a PLN the user builds, maintains and activates a network based on her personal trusted connections. By contrast, a SLN is a wider network, which involves everybody in the system. Rajagopal et al. offer a conceptualization of PLNs with particular relevance on people using tagging mechanisms to engage interactions among users [Rajagopal, 11]. Rather than foregrounding the technology, they concentrate primarily on "the act of making connections with other professionals" and the skills associated with it. Key to these skills, they argue, is "the ability to identify and understand other people's work in relation to one's own, and to assess the value of the connection with these others for potential future work". Three primary tasks: "building connections (adding new people to the network so that there are resources available when a learning need arises); maintaining connections (keeping in touch with relevant persons); and activating connections with selected persons for the purpose of learning" [Rajagopal, 11].

We follow these approaches to understand how people tagging other people (and resources) work as a useful mechanism to improve connections. By including automatic and manual scaffolding mechanisms to support decision and connect with other people and expertise in a professional SLN, additional depth is afforded to practice exchange.

2.3 Networked Scaffolding

To reach the next level of understanding in complex environments, the nuances of task needs unpacking in detail. Common practices between trusted peers within the same organization, but could also be supported in wider network settings (i.e. professionals outside of the organization). Therefore, there is a need for understanding how the scaffolding that happens in a PLN could also be supported in wider online network settings such as SLNs. Scaffolding extends the cultural-historical approach of Vygotsky [Wood, 76]). Scaffolding requires a shared understanding of the goal of the task between the tutor or 'more capable peer' and the tutee. The more capable peer must calibrate support based on an ongoing diagnosis of the student's level of understanding. This calibrated support requires the tutor to constantly fine-tune the support based on the student's changing knowledge and skills.

We suggest a new concept of 'Networked Scaffolding' which aims to explain how scaffolding and its application can be applied within work-based contexts. Networked Scaffolding extends the scaffolding metaphor from a situation where learners are interacting with single tutors in reality to a situation where scaffolds emerge as a result of a number of learners (peers) interacting in a digital informal learning network. Our approach includes the interaction of these peers with artefacts and services: services such as recommendations and question-answering. However, a prerequisite to the use services (incorporating intelligent algorithms) is an understanding of the networked environment within which our professionals operate. For this reason, a key need is to understand our approach by using existing networking technologies and proof of concepts to collect feedback from users in the workplace.

3 Case study

The following case study represents a rich case in its own right: comparing and contrasting our healthcare professionals' feedback offers a rich and deep analysis. The design based research study was guided and framed by the introduced theoretical base.

The main research questions for this study are:

- How do members of healthcare networks go about help seeking activities in the context of their professional practice? Are such help seeking activities conducted differently online?
- How do members of healthcare networks assign 'trust' to people and documents?
- What are the objectives to ask someone a question and what are the drivers to deliver an answer?

3.1 The Networks Studied

The University of Leeds and Yorkshire and Humber Commissioning Support Unit (CSU) are partners in the project and are responsible for the work taking place in healthcare. The CSU provides support to all the Clinical Commissioning Groups (CCGs) across Yorkshire. CCGs are clinically led groups that include all of the

General Practices (GP) groups in their geographical area and give GPs and other clinicians the power to influence commissioning decisions for their patients. Collaboratively, in this study, we have identified three healthcare networks during the first year of the study (2013), which have been invited to take part in the research. These networks are established in a large city in West Yorkshire (UK). These networks bring together professionals from different GP practices within a Clinical Commissioning Group (CCG).

The empirical studies, stakeholder engagement and co-design activities conducted during 2013/2014 have been used to understand the main characteristics of these networks and to identify their main needs. Our design team has engaged in iterative co-design redefinition. The work has also been influenced by the ongoing empirical studies of how healthcare professionals currently learn in the workplace [Thalmann, 13]. Several "systemic pain points" (areas in the healthcare professionals' workplace learning where they feel they currently encounter problems) were identified. These include: (1) Lack of time and mobility issues. (2) Cascading Learning & Training: ensuring that new national guidelines (or other learning resources) are shared, understood and implemented within the practice. (3) Collaborative working and learning: learn from each other's experiences when developing their implementation plans. (4) Support exchange of opinions and discussions: the formal procedure is followed to bring together face to face the relevant healthcare professionals to review a significant event. Some staff have suggested that there could be benefits to opening up these discussions more widely (across the practice and potentially even to other practices). (5) Nurses/Healthcare assistants mainly rely on face to face support and help seeking, meaning that they are restricted in terms of whom they can ask especially as opportunities for taking time away from the clinic to attend cross-organisational training or networking events are limited. Finally, (6) Trust has been found to be a key aspect when seeking support, but which are the specific aspects of Trust that need to be considered when individuals move from local trusted peers out into wider discussion groups. Further details can be found in [Santos, 14].

Below the main findings for each network are summarized:

The Practice Manager's Network (PMsN) is a well-established small network composed of an effective core group of members. They have regular monthly face-to-face meetings to exchange opinions, expertise and deal with common problems (i.e. dissemination of changes to practice). Currently, they use email to exchange questions and answers to handle these needs. The network has the need to improve the mechanisms for sharing, because the current use of e-mail PMs gives the feeling of losing information and not having any control over their network of contacts (see details in the analysis below). One of their main aims is to expand the group: i.e. involving more Practice Managers from their geographical area. Even if they are keen to go outside on some questions, they want the core group to still be just from within their CCG. The reason for their interest in expansion is to improve their networking capabilities to strengthen their voice and impact of the PMsN within the CCG.

The Nurses Network (NN) is a new small network where most of the nurses work single-handed at their practices and hence, feel a little isolated. This is due to the fact that many GP practices only have one nurse workingyes in them or a few part-time

nurses with very little overlap with their peer workers. Nurses have regular face-to-face meetings, but with variable attendance due to the lack of time or staff availability. Additionally, nurses have little communication and sharing by e-mail. Their main aims are to have self-supported technological platform and expand this new group (currently it is led by the CCG in contrast to the self-organized Practice Managers Network). Furthermore, they are in need of adequate mechanisms for improving the sharing of questions, knowledge, expertise and concerns. They want to explore the potential for *mentoring* within the network, and use the virtual community to support their professional development. As in the case of the PMsN they also want to strengthen their voice and impact in on CCG-wide decisions.

The Data Quality 'Network' (DQN members do not have an existing network at the moment. For this reason, it is hard to find out who has a similar role in different practices. Furthermore, not all practices in this area have someone employed in this professional position. The DQN members can feel quite isolated. One of the main needs is to share good practices. Data Quality group's main aim is to establish a network to share issues around workload, knowledge, expertise and problems, hence, again having similar aims as the other two networks.

As we can observe, except slight differences all three networks want to exchange informal knowledge about their profession and need a well thought (in terms of information overload) and easily usable tool to support these needs.

3.2 Workshop Design and Methods

The stated research questions have been studied in two workshops. Participants were invited to attend two 2-hour workshops. The goals of the workshops were to show existing social media (e.g. Linked In) and a first functional prototype, discuss their potentials, benefits and limitations and co-design the idea of the prototype further. PMsN and DQN were grouped together since they do work closely, and the NN session was run separately. Besides, reasons for separating were the PMs – PNs (Practice Nurses) power relations. This resulted in a repeated administration of each of the workshops per day and the following sample sizes:

- Workshop 1 (April 2014) - *'Social networks for improving your professional networking skills'* : 8 Practice Managers, 1 Assistant Manager, 1 Administrator, 1 Data Quality and 4 Practice Nurses. 1 participant was male and 12 female
- Workshop 2 (May 2014) - *'Co-designing technology for help seeking and scaffolding of learning'*: 7 Practice Managers, 2 Assistant Manager, 1 Data Quality and 5 Nurses (7 of the participants had not attended to the 1st workshop). 3 participants were male and 12 female.

The findings of the both repeated workshops were incorporated into the inferred design criteria. The data collected (see Table 1) was first analysed and next triangulated in order to obtain trustworthy results.

Using a case study approach to frame these specific workshops offers key benefits to the project. Bound by a shared interest in developing an online social

network for practitioners (via the Q&A tool), we need to seek out both the process of learning about the case, and product of our learning [Gomm, 00].

As a case study can include multiple methods, we draw upon multiple data collection tools within the case such as questionnaires, researchers' field notes, observations and practical tasks are compatible within the case approach, and will inform what we can learn from it.

During the research activities we have followed a co-design approach [Spinuzzi, 05] with work-oriented design of computer artifacts in order to understand steps that healthcare staff followed using the tools.

Data source	Type of data	Labels
Pre-Questionnaire-workshop1	Quantitative and qualitative answers of the participants used to know their background data and previous expertise with Professional networking tools and social media.	[PreQW1]
Post-Questionnaire-workshop1	Quantitative and qualitative answers of the participants after doing the tasks of workshop1.	[PostQW1]
Observations-workshop1	Observers' notations extracted from observations during workshop 1.	[ObsW1]
Post-Questionnaire-workshop2	Quantitative and qualitative answers of the participants after doing the tasks of workshop 2.	[PostQW2]
Observations-workshop2	Observers' notations extracted from observations during workshop 2.	[ObsW2]

Table 1: Data Collection Techniques

3.3 A Question-Answer tool to support the Healthcare

A functional proof-of-concept (beta 1) was developed analysing the empirical studies collected during 2013/2014 and the preliminary results obtained from 'workshop 1'. The reason behind quick proof of concept was to understand the participants' behaviourbehaviour in relation to our main research questions (see section 1.3.2). A WordPress installation was found as an adequate solution due to its low-cost and easy integration with existing social/networking plugins. This proof-of-concept allowed us to install the following features: Create a private account, build a PLN, share opinion and resources by using two different mechanisms: (a) exchanging questions and answers through the Q&A plugin, a system especially designed to exchange questions and answers; and (2) exchanging discussions in a Forum, where 'free style' discussions, were supported.

4 Analysis of the Healthcare case study: themes

We observed that the themes emerged during the 1st workshop and evolved during the second one. For instance, regarding the first theme 'How Technology affect Help Seeking Practices, Networking and Time issues (Information overload) at Work" we observed how information overload (via email) and lack of time were important issues raised by the participants in both workshops (see Table 2). In relation to the second theme 'Who do I Trust? ….' during the first workshop we identified how participants felt insecurity when building new connections in professional networks;

for this reason we explored this issue further during the second workshop and observed how participants tend to 'trust' local/proximal similar peers. The third and fourth themes (Table 4 and 5) were identified after comparing the current participants' behaviourbehaviour without using any technological solution (workshop 1 results) and their behaviour (or expected behaviour) by using the proof of concept (workshop 2 results).

Each theme is summarized in a Table format (see Tables 2, 3, 4 and 5). The Tables show the findings of the case for each theme under analysis. Each finding is identified with a code (i.e. F1T1, which means Finding 1 of Theme 1) and we use these codes in the following section to describe our derived design criteria for the Q&A tool; hence the codes achieve the purpose of cross-referencing. The second column shows the preliminary results that support each of the findings, extracted from the data gathered during workshops 1 and 2. The third column refers to support data (i.e. observations, qualitative and quantitative data from questionnaires) selected as exemplary information to support the preliminary results. Each support data makes reference to the codes detailed in Table 1 to identify which data set it was taken from.

The analysis of the corresponding emerged themes is used to propose a set of design criteria (presented in the following section) for the work in progress of the Q&A tool.

4.1 How Technology affect Help Seeking Practices, Networking and Time issues (Information overload) at Work

One particular need of these networks (PMsN, DQN, NN) is to have the possibility of accessing useful information and contacts at the right moment. The following theme identifies how the current use of email is associated to the feeling of information overload and staff has the need to improve their seeking of support (Table 2).

4.2 Who do I Trust – some would trust 'local' and 'similar to me' contacts, others national contacts with expertise in the field…Who can see me/ can I see? Making contacts and accepting invites.

The following findings (Table 3) points to the local nature of trust which provides some support for our PLN approach, where workers build, maintain and activate a PLN using trusted contacts (who essentially scaffold them) and at a later point we see workers branching out into SLNs.

4.3 Scaffolding the seeking and sharing of opinion within your online network

The data gathered from the workshops shows how participants have an interest in improving their networking practices particularly in sharing knowledge and opinion; however, this exchange of knowledge needs scaffolding support in order to improve the effectiveness of sharing practices. Especially scaffolding will be provided to support help seeking actions (i.e. creation of Q&A, finding experts, tagging learning resources). Moving from personal to wider networks requires scaffolding, the 'System Scaffolding' strategy can provide recommendations from the system based on the interactions of the users. The combination from the Community scaffolding and the

System scaffolding is what we call the '50-50 partnership' human/computer interaction [Cook, 2015]. Table 4 shows the corresponding findings evidencing the previous statement.

4.4 Supporting help seeking through the exchange of Questions and Answers and overcoming issues of isolation

The exchange of questions and opinion is a common practice in this context; even in break times during the workshops participants used the opportunity to exchange Q&A with their peers. The data collected during the workshops helped us to understand how to support the creation of questions, and the exploration of the network (i.e. contacts, groups, resources) by using existing questions. See the corresponding findings in Table 5.

Findings	Preliminary results	Selected support data
F1T1: Communication by email is essential in the Heath sector, but improvements are needed to allow Healthcare workers to organize, filter and find the necessary information (resources and contacts) easier than using the classic e-mail system. Besides, it is necessary to identify how notifications have to be alerted without increasing the overload of information they receive every day in their e-mail account.	-One common systemic paint point is related to information overload (email) and how to manage their time. -Participants are familiar with the sending of e-mails (but tedious because of the huge amount of e-mails per day). So they want to communicate on issues of interest more quickly with others interested in the area - Concerns about the fact of receiving 'notifications' to their e-mail, especially if not directly relevant to their work.	-All participants confirmed that the most common method of establishing their network is by face to face (f2f) meetings (13/13) or by exchanging e-mails (11/13) [PostQW1]. - *"... comment was made that 'some' PMs do not read their e-mail."* [ObsW2]. - "*This is the way forward – this is how we are going to communicate more than once a month than at the group PM meeting, without wading through a load of e-mails*"; "*I didn't see the benefit of LinkedIn but I do for this.*" [ObsW2]. - "*Public/private nature of communications and where do notifications go?"* [ObsW2].

Table 2: Theme 1: The way technology affects Help Seeking practices, networking and time issues (information overload) at work.

Findings	Preliminary results	Selected support data
F1T2: Trust (or the encouragement of trust) seems to be associated to specific 'Key Profile Factors': Location (internal or external to the organization, regional or national/international), Professional role and Interests seems to be key factors for decisions when accepting a new contact. The provision of these details can reduce the SPAM feeling of classic recommendations.	-Location seems to be related with trust and the process of making new connections. -Need to provide mechanisms to help users to find other similar colleagues by location. In particular 'proximity' is important to share 'solutions for similar problems'. -Connect with peers *'similar to me'* is an important factor when establishing new connections (and trust) and expand the PLN -There is an issue raised about ignoring suggestions that do not relate to my professional identity	-For 100% of participants, it is important to have the possibility of having easy access to similar colleagues currently working in the same organization, regional area or having similar profile [PostQW2]. -8/13 participants would like to find new contacts considering their commonalities with the new peers (in terms of expertise, location, skills…). And 10/13 participants are generally positive with the functionality 'accessing peers similar to me' [PostQW2]. - *"There was some discussion around how to decide whether to accept invites to connect from people you do not currently know. One of the Data Quality Leads had been a member of LinkedIn for some months and had noted that they received a lot of SPAM from LinkedIn. By SPAM they meant invites to connect to people who they did not know. Their view was that their connections in LinkedIn should only be people who they actually do know already (who they have met either face to face or online)."* [ObsW1].
F2T2: Automatic recommendations (of new contacts or groups) seem to facilitate the process of expanding a personal and trusted network; These results confirm the importance of having a tool which allows the differentiation between Personal Learning Networks (formed by personal trusted peers) but also a Shared Learning Network (public groups).	-Participants showed interest in interconnecting with 'similar groups' -'Who are the members' seems to be a basic reason for joining a group in addition to knowing the common questions/topics discussed by the group. -Trusting the members of a group is essential in order to share information within the group. -Participants identified very clearly the 'privacy' of the group and 'who are the members' as key issues.	- *"Some delegates really interested about the 'recommendation' LinkedIn can provide to national bodies and groups, others keener to link with 'someone like me' in my local area i.e. more likely if (CITYX)"* [ObsW1]. -*"Groups and who is to be in/out are crucial to building confidence"* [ObsW2]. - 12/13 participants show a strong support in front of the possibility of creating groups of contacts [PostQW1]. - *"Public/private aspects are useful"; "Small groups ideally private - useful for conversations with selected peers; doesn't want the main commissioning body to have access"* [ObsW1]. - *"Blanket e-mails are really problematic for practice managers, and having a system 'outside' [of email] would be really useful."* [ObsW1].

Table 3: Theme 2: Who do I Trust? – Making contacts and accepting invitations.

Findings	Preliminary results	Selected support data
F1T3: Sharing information and opinion is very important for these professionals. But levels of privacy and access felt to be an important issue to consider when sharing information and opinion with other peers. Specifically, to consider hierarchical relations between different professional profiles, such as relation of power or mentoring activities, need to be considered.	-The data gathered from the workshops shows how participants have an interest in improving their networking practices particularly to share knowledge and opinion -Different 'sharing' behaviors were observed when participants plan to use private vs public groups of discussion. - Many nurses would value having more mentoring support. This means to support the connection between novices' practitioners and 'more capable peers'.	-"*PMs and DQs were happy to share. As they found people on LinkedIn they immediately spoke out to the whole group and told them about anything interesting they had found.*" [ObsW1] - 100% in positive favor of starting a discussion or sharing with an online group [PostQW2]. -When they were asked about sending a private message to a person who doesn't belong to their PLN, the majority of the participants (11/15) was unsure or didn't feel comfortable with this option [PostQW2]. - Participants would use a private group when: "*Trying to find information relevant to the work that the group is undertaking" [PostQW2] or because "...not all information is relevant to different areas of the country as they might all be working on different projects.*" [PostQW2]. -They would use a public group (particularly going across job roles) when: *"There are some things that ALL need to know." For instance: "There is a PN meeting planned for XXth June"* [ObsW2] -*"a more experienced Nurse who has been actively involved in the network has offered to support some less experienced nurses from other practices. She also gave her mobile number to the newer nurses who had subsequently called her or sent her texts to ask her questions.*" [ObsW1].
F2T3: Tagging to help focus on relevancy. In the future it would be necessary to identify, and categorize specific examples of pieces of information (i.e. tags) and learning resources that healthcare staff need to share in order to support their opinions.	-In order to facilitate the searching and filtering of information the use of Tags seems to be generally accepted as a good solution -In terms of sharing resources, participants showed some concerns about the type of content of what is or could be shared (especially related to patient privacy).	-10/13 of positive feedback about using Tags or categories to organize data [PostQW1]. -39% positive to assigning a tag to the profile of a work colleague. However, 46% are sitting on the fence and 15% (a significant number) think such a facility is not important [PostQW2]. -*"Like ideas of uploading documents, adding in summaries, condensed notes ..."; "At moment we have nowhere to upload documents and say how to use them."* [ObsW2].
F3T3: Further understanding of the use of 'marking' terms (i.e. 'Important', 'Solved', 'new connection') is necessary in order to understand the privacy of these opinions.	- 'Like' or 'Solved' actions are a way of sharing opinion, but after discussing the difference of these terms with our participants they show different interest about these actions. -Participants don't feel that terms 'friend/unfriend' are appropriate in a professional network environment.	-A 'Like' action is very common in Social Networking tools, but half of the participants seem to be very uncomfortable with this action. On the contrary the majority of the participants (11/13) found very useful to mark a discussion as 'Solved' [PostQW1]. -"*Some uncertainty about the voting"; "'Like' would be better used as a personal indicator or tag (perhaps importance or usefulness?)*" [ObsW2].

Table 4: Theme 3: Seeking and sharing of opinion within your Online Network

Findings	Preliminary results	Selected support data
F1T4: Providing information to the user as showing similar questions could have a beneficial impact when participants have to create a new question. Notifying users of similar questions could be useful to discover if her question has been already answered.	- Questions were phrased in a way that asked what others' experiences were and what their normal procedures were. Usually the person asking the question sought multiple answers. Examples of 'typical ways of asking questions' could be studied in the future. -The behavior observed when asking/answering questions shows the need of scaffolding in terms of phrasing questions to elicit best response. -Participants showed interest when they understood that questions could be related to specific subjects/topics and be shared with specific groups.	- *"During breaks and over lunch, the group naturally started asking each other questions regarding issues they were currently encountering at work."*[ObsW1]. - *"The form of the questions was usually along the lines of "What do you do when...." rather than giving a specific case and asking for advice on what to do.*[ObsW1] - *"The title of the question is very important, and could also be useful in finding out what questions and answers have already been posted / asked. However, there could be subtle differences and nuances between similar questions."*; *"Question asking bit annoying at first if has title similar to one already posted (e.g. if put QOF at front) but became clear that could help see if question already asked and way around it discovered (putting key word at end)"* [ObsW2].
F2T4: The differentiation between q&a shared publicly (within a wider network) and those ones shared only in personal and trusted groups, confirms the importance of the distinction between Personal Learning Networks (PLN) and Shared Learning Networks (SLN).	-Privacy issues are also raised when discussing with whom the question could be shared. -'Urgency' in terms of obtaining a useful answer in a short period of time, seems to be only necessary when they don't know who can provide support to their question. In this case, they prefer to share their problem/question with the SLN	- *"Questions around broader subjects specific to everyone i.e. QOF"* would be share within a public group [PostQW2]. - *"Question raised as to whether Questions can be organized by topics; for example. questions could be assigned as those for the PN Forum / Network to address."* [ObsW2] - *"There was a sense that depending on level of engagement, users should have particular access and usage rights."*[ObsW2]. -8/13 participants show interest in having a SLN where sending public questions [PostQW1]. -11/15 found useful to send a private question/opinion to a specific person [PostQW2].
F3T4: Having a data base of questions, would be potentially useful to: recommend similar questions; and to expand the PLN and reduce feelings of isolation.	-Having a 'critical mass' of users using the system and exchanging Q/A is essential. -The exchange of Q/A between similar peers has the potential to reduce feelings of 'isolation'.	-*"Would also like the facility to create and link to other relevant groups (e.g. PMs) in order to open up communication channels for particular purposes."* [ObsW2] - *"If used regularly by all members on the group then it can be a very effective way of having discussions and useful for exchanging questions and answers."; "They themselves (Nurses) commented that the tool would only really work if enough Nurses used it. They recognized the critical mass issue."*[ObsW1].

Table 5: Theme 4: Exchange of Questions and Answers and overcoming issues of Isolation

5 Design Criteria to implement a Social Semantic Q&A tool for supporting help seeking actions

The analysis presented in the previous section has been used to propose the following three design criteria (in terms of technical requirements), which have been considered to design and develop services to support help seeking. The first iteration of services are developed by Graz University of Technology (TUG).

Figure 1: Question with attached Multimedia

The Q&A tool [Dennerlein, 13; Dennerlein, 15b] relies on the SSS [Dennerlein, 15a] and the services it provides, such as Q&Aenrichment by multimedia and intelligent recommendation services. The multimedia Q&A enables users to start a question related to a certain already gathered document (see Figure 1) or a simple text based question, for example: 'How do you deal with registered patients who have not passport'. Once the question is stated, the SSS is queried for similar questions (see Figure 2).

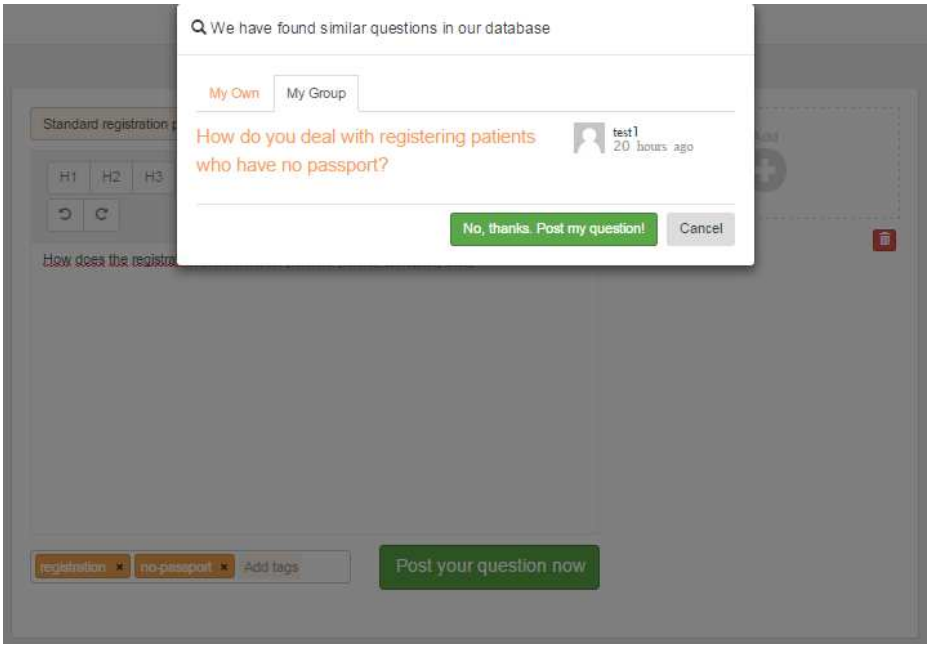

Figure 2: Recommended Question from Learning Network

This shall motivate the help seeking person to elaborate on existing knowledge and keep it up to date, if the suggested answers from the learning network didn't satisfy the help request. In case of no available appropriate question, a new question is created for the learner (see Figure 1). This question then needs to be further detailed via a title, a short description, tags and needed multimedia artifacts such as pictures,

videos, documents or links. In the example in ***Figure 1***, pictures of passports have been attached to specify the context and problem, i.e. the missing passports. All of these metadata enrich the understanding of the question by providing additional contextual information, and build the basis for later intelligent services such as recommendation. Afterwards, the question can be shared either publicly, with a group or a specific person. The respective collaborator(s) have then the chance to answer the questions on text basis and/or via the provision of multimedia artifacts such as a guideline of how to behave in case of no available passport or a link to a national homepage giving advice on the subject. These answers can be commented by the participants and ranked in a collaborative effort to decide on the best fitting answer or the most appropriate set of answers. To facilitate this process, a filter mechanism is provided based on rating or date to personally structure the answers and a search mechanism to raise awareness taking the defined sharing characteristics into account. Finally, all question-answer activities of collaborators are reflected in the history of shared groups to further increase awareness and keep the collaborators "on board". In this way, a living database of questions and answers is built, extended on demand and meaningfully revised so that not only single decision making attempts are supported, but also further taken up (by others) when needed.

The following criteria have been used to understand the relation of the design criteria used to develop the Q&A service and the findings from the case study:

Criteria 1: Scaffolding will be provided when…

- …composing questions and as an alert to similar questions for decision-support (based on finding F1T4). When a question is created in the Q&A service, the SSS services check for similar questions already created in the system. At the moment three different algorithms have been applied to find similar questions when trying to post a question: (a) *Label/description search* - tries to find words from within the entered label and description in already existing questions; (2) *Tag search*- tries to find question tagged with the same tags as entered for the new question; and (c) *Collaborative Filtering* - the algorithm finds similar users (the so-called neighbors) for the target user based on questions the users have interacted with in the past (i.e., if there is an overlap in the resource-lists of two users, they are treated as 'similar peers' or neighbors) [Schafer, 07]. Then the algorithm suggests the questions of these neighbors to the target user. At this stage we assume if two users had a "similar interest" in one issue, they will also have a "similar interest" in another issue.
In situations where we cannot create enough suggestions, for instance because the target user has only a few or even no questions in her resource-list (the so-called cold-start problem), we populate the question-list with the most popular questions in the system. Particularly this means: find users who have dealt with same questions 'as I did'; find questions they dealt with 'and I did not (yet)'; exclude questions from the result 'I already have / own'. Our future plans include evaluating the suitability of these algorithms.

- …the user is not sure about how to formulate her problem (F1T4)
Currently we are exploring the possibility of identifying Problem-Based Scaffolding Patterns [Pata, 15] (discussed during workshop 2). This means that the Q&A service

will provide guidance to help the users to formulate their questions based on identified 'Problem types' as examples of forward and backward reasoning.

-…searching, finding existing groups, and filtering information

The Q&A service should allow staff : to organize or filter information and provide relevant notifications highlighting issues to prevent or better handle information overload; and provide relevant notifications highlighting issues (e.g. recommend similar questions and 'similar peers to me') based on the finding F1T1 to support decision-making. The tool may also provide a centralized repository of records and resources that the network has previously discussed and agreed upon, which can be subsequently updated and re-used (i.e. questions and answers, as indicated in F3T4). The idea of addressing information in public and private groups seems to be an adequate solution for distributing information to the correct people (according to findings F1T3, F2T4). We have to investigate (in future co-design sessions) the different artifacts (i.e. questions, documents, people), which lead to discussions and automate the discovery of those objects (see finding F2T2).

Criteria 2*:* Key Profile Factors and Trust issues

There is a need to identify how professionals can build their local trusted PLNs that should include 'Key Profile Factors' (see related finding F1T2). As we mentioned above, participants show strong support for the possibility of connecting to new peers 'similar to me' or to 'more capable peers' and creating groups of contacts. We think that using social data (from existing social platforms but also added by our users) to build Key Profile Factors have the potential to facilitate *trusted connections*, and can be used as a scaffolding mechanism to help users to organize their group of contacts in 'Circles'. Based on our analysis of the answers in the workshops, the following details were proposed by the majority of participants as the most important: (A) Specialised professional skills and experience/ specialty and (B) Contact details: location (F1T2), place of work/address, contact number and e-mail; and (C) Past postings: questions and answers included in the SSS. The first element (A) confirms the importance of identifying colleagues 'similar to me'. Knowing the competence of each user can be used by the SSS to recommend groups where a relevant discussion is taking place. Recommendation of existing groups could potentially be a good mechanism to expand a PLN (finding F2T2). In that sense this finding is related to the identified need of showing in public those people that are members of a private group (F1T3). 'Who are the members? ' seems to be a basic reason for joining a group (and trust them) and in addition there is a need to know the common questions/topics discussed by the group. In particular we will explore further the importance of 'geographical proximity'. Boschma [Boschma, 05] says that although 'geographical proximity' facilitates interaction and cooperation, it is not a sufficient condition for interactive learning to take place. For this reason, the combination of other dimensions of proximity, such as 'cognitive proximity' or what we call 'similar peers in the same organization' have to be explored. As well as the contrary case when professionals need to find experts 'the more capable peer' will be suggested to solve their problems or to counter opinion.

Our future plans include to further understand the relation between a peer 'similar to me' and the 'more capable peer', in which cases the users decide to be more comfortable with 'similar', and in which they prefer to seek expert / specialist help? We want to further understand how the recommendation of new connections and the exchange of opinion can engage 'reciprocity', i.e. intersubjective meaning making [Suthers 2006], among members. We need to explore how to combine automatic methods (from the system) but also manual methods (from the users) to recognize 'more capable peers' (i.e. when a preexisting question is recommended to a user, he does not only find potentially relevant answers, but is able to identify more capable peers in the list of contributors).

Members of these networks may also acquire, actively take on a role or become recognized as an expert in specific areas / domains (this already happens within the PMN).

Finally, we have observed that although automatic recommendations (i.e. of new contacts by LinkedIn) seems to facilitate the process of expanding a personal network, from our observations we think that providing details of the key profile factors when users make new connections can avoid the "SPAM" feeling when receiving recommendations (of people to link to) as highlighted in the finding F1T2.

Criteria 3: Tagging as mechanism to aggregate trust

In order to facilitate the searching and filtering of trustworthiness information the use of tags seems to be generally accepted as a good solution (finding F2T3), particularly with a positive finding with respect to using tags to find a relevant question/answer, contact or discussion group. During the 2nd workshop, participants started to understand the meaning and potential of using 'Topics, Categories and Tags' to organize their shared information. However, our findings also indicate to us that the issue of tagging a user's profile needs further exploration (during next years 3 and 4). The research undertaken by TUG, supports the importance of combining the manual addition of tags with automatic, personalized tag-recommendation services [Kowald, 14]. In this context, work in progress is focused on developing recommendation services to support the problem of predicting/recommending items (in our case Q&As, people and resources) in social networks. This will be achieved by integrating algorithms that have already been developed by TUG in the course of Learning Layers for recommending resources.

Service implementation efforts for question-answering, recommendation, metadata and sharing knowledge within SLNs, can be found in the Learning Layers GitHub repository inside the Social Semantic Server project (https://github.com/learning-layers/SocialSemanticServer).

6 Conclusions and Future work

This paper presents a case study in a real professional Healthcare environment with the aim of understandig how to support online collaborative help seeking actions and decision support processes through the exchange of questions and answers. The findings from the case study have been transformed into three main design criteria used to develop a first iterarion of services for a Q&A tool. The results confirms the

importance of providing scaffolding through the creation of questions and answers in order to find similar problems solved by other peers in the organization; from the results we have also identified the 'Key profile factors' needed to facilitate connections between peers in the network; finally, tagging problems aggregates trust and helps users to find answers for their questions.

To conclude, the change in perception of the participants between the first and second workshop was striking and of particular interest to us: i.e. the professionals' perceptions of and attitudes towards Social Networking tools in general, and the future co-designed 'Q&A tool' in particular changed completely to the positive. Our next step is to integrate the Q&A in the HC workplace context and understand how the service is used to support the seeking of help actions and facilitating the establishment of trust for enhance decision-making. In particular we want to explore further how trust can be agreggated through the combination of a'Community Scaffolding' strategy, where effective answers emerge from the connection between peers and experts; and with a 'System Scaffolding' strategy, where contextualized recommendations will be delivered from technological services from within the SSS. This combination is what we call the '50-50' partnership [Cook, 2015]. This issue will be evaluated in future co-design sessions. As we have previously described, current services facilitate the tagging of Q&As, enrichment of Q&As with multimedia resources, voting of answers (although we need to further understand professional voting mechanisms beyond the 'Like' action (see finding F3T3), sharing of different Q&A threads with colleagues/groups and search and recommendation of similar existing Q&As. Future service developments include the categorization of Q&As, extended search and filter mechanisms and the ability to manually or automatically identify a group of answers as a final solution to a question. Current and future services enabling scaffolded Q&A will be main elements of the future SSS. The actual evaluation of these social semantic services will be administered and reported.

Finally, a key concern is the personal, team and organisational impact - introducing any tool into the workplace (even one designed through co-design) - is likely to involve some changes in working behaviour/practices. Our aim is to integrate the question-answering and recommendation services from within the SSS, and to implement an integrated Email service in order to reflect in the SSS the emails sent by users' organization accounts. We will continue our co-design studies with the healthcare sector, but our plans also include scaling up our solution to other domains such as the construction in Germany (formal application partners in LL). The comparison between different workplace sectors will allow us to understand the similarities and differences between informal learning across contexts in workplace environments.

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