The potential of smartphones to mediate intra-hospital communication and learning practices of doctors. Preliminary results from a scenario-based study

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Abstract
The article reports on the potential of smartphones to support doctors' intra-hospital consultation and learning practices. Interviews were conducted on the basis of text and video scenarios to explore the doctors' accounts of, and expectations towards smartphone-based consultations including the generation and exchange of clinical images and videos with remote specialists. The participants associate only small changes resulting from mobile-teleconsultation with respect to their learning. They strongly welcome, however, the opportunity to bookmark the multimedia-enriched patient cases generated on their mobiles and share these with colleagues in further informal and formal work contexts to support organisational learning in highly mobile, clinical environments.

Keywords
mobile learning, hospitals, organisational learning, workplace learning, tele-consultation, clinical images and videos, smartphones

Context
While hospitals' first priority is patient care, clinical contexts also provide the basis for doctors' competence development and professional education. To date only a few studies have explored doctors' workplace learning. They show that it is not so much centred on explicit intentions and deliberate practice but closely embedded in daily work processes. Learning is triggered by problems emerging from patient care that that are based around complex interactions (Slotnick, 1996). Doctors mainly learn from their cooperation and communication with colleagues and other specialists in daily work routines. (van de Wiel, Van den Bossche, Janssen, & Jossberger, 2010). As specialisation in hospitals requires a continuous flow of people, knowledge, resources or tools across different places in order to accomplish work (Bardram & Bossen, 2005), it becomes evident that doctors work and learn in highly mobile contexts. They cannot exclusively co-operate on site: an essential part of the discussion and consultation processes between them is based on (in-house) telephone calls in order to connect to, and communicate with remote colleagues.
Newer technological developments such as smartphones not only allow voice-based communication but also support doctors' co-operation through the exchange of images, videos and even video streaming. In several studies the smartphone-based exchange of images showing soft tissue injuries and radiological content (CT, MR, ultrasound) was investigated, for example in the fields of surgery and dermatology (Ebner et al., 2006; Ebner et al., 2008; Chung, Thomas Yu & 2, 2007). Technical requirements and diagnostic quality of the images were found suitable to support remote evaluation and medical decision-making. (Compare for example Hsieh et al., 2005; Tsai, Pong, Liang, PY & Hsieh, 2004; Chung et al., 2007; Yamada, Watarai, Andou & Sakai, 2003; Kim, Yoo, Park & Kim, 2007). It was recognized that images "give substance and life to the description conveyed over the phone" (Lam, Preketes & Gates, 2004). Also, the use of a system capable of videoconferencing between the point of care and a remote consultant has been piloted (Banitsas, Georgiadis, Tachakra & Cavouras, 2006). Only a few studies, however, highlighted, learning aspects, for example in the field of 'mobile' just-in-time support. Piek et al. indicated that junior doctors

learned over time to improve image selection relevant for decision-making by the senior doctors they consulted (2006). Others mentioned the re-use of the documented materials for further teaching and follow-up meetings (Blaivas, Lyon, & Duggal, 2005; Tai Khoa Lam, 2004).

Methods

The study was conducted according to the principles of scenario-based research (see for example Carroll, 2000). A brief story provided a stimulus of how smartphones can support the physicians' clinical consultation and communication practices: first, a written scenario (see also Pimmer, 2009) that was created by doctors on the research team was provided to 13 clinical doctors from a Swiss hospital covering all levels of seniority. The scenario was centred on a smartphone-based consultation process between a junior doctor in the emergency department and a specialist. The emergency department was chosen because of the frequent interactions that take place there with specialists from all clinical departments. The remote consultation described in the scenario entailed the exchange of clinical images and videos. The scenario also showed how doctors marked interesting patient cases and re-used them at a later point in time.

In subsequent semi-structured interviews the participants were asked to provide critical feedback on the scenario presented to suggest further ways in which smartphones could be used and to describe the impact on their work and learning practices. The interviews were transcribed verbatim and divided among three researchers. They independently analysed the data using inductive content analysis: while the "learning episodes" in the scenarios served as points of departure the analysis was essentially grounded in the data.

Preliminary findings

The analysis of the interviews revealed interesting insights into learning associated with existing consultation processes as well perceptions on smartphone-supported consultation and communication processes from a learning perspective. In line with the findings in the literature the data supported the view that doctors consider smartphone-based discussion of patient cases - enriched with clinical images and information - as suitable for increasing both efficiency and quality of their consulting processes with remote experts. They perceive there to be rather neutral effects of the mobile teleconsultation on their learning, however: the visually enhanced consultation with remote specialists was not expected to completely replace on-site investigation by specialists. The on-site investigation of patients through specialists as part of a consultation process was, in turn, seen as a rich ground for learning and teaching practices from which the participants would continue to benefit.

Second, the doctors highly welcome the opportunity provided by the devices to bookmark particular learning experiences in the workplace and carry these into further informal and formal contexts. In particular, the functionality of the devices to capture multimedia-enhanced patient case information at the point of care and to re-use them in other social contexts within their work team, in rapports, for formal teaching purposes or at congresses was seen as a highly valuable from an organisational learning perspective. It also became evident that there are no tools available to document and re-contextualize ad-hoc learning experiences in highly mobile work contexts and transfer them into further "learning" situations. Smartphones were seen as instruments being able to address this gap.

Third, we explored a number of contextual and biographical factors that impact on smartphone-mediated learning such as time (pressure) and workload, interruption-driven environment, experiences and skill level of junior doctors, trust and personal preferences.

Discussion and outlook

While mobile learning in workplaces is becoming more and more popular in general (see for example Pachler, Pimmer & Seipold, 2011; C. Pimmer & Gröhbiel, 2008), clinical and medical contexts are of particular interest (Kho, Henderson, Dressler & Kripalani, 2006).

Portability and connectivity of mobile devices can support and transform organisational information and communication practices of doctors who work in highly mobile work environments. Not only remote but also co-located practices of smartphone-mediated communication have to be taken into account for further research. We also posit that learning technology has to be closely embedded into social work practices so as to be accepted by users in busy clinical environments. In the design and research of mobile learning particular attention has to be paid to the stimulating but also conflicting relationship of learning and work (Stok-Koch, Bolhuis & Koopmans, 2007). From a theoretical point of view we pretend that in order to more fully understand the complex phenomena of mobile learning in hospitals comprehensive conceptual approaches have to be taken into account that not only address cognitive aspects but also comprise the analysis of socio-cognitive, cultural and organisational dynamics of workplaces (see also Pimmer, Pachler & Attwell, 2010).

Acknowledgements
We thank our project sponsors and partners, CTI - the Swiss Confederation's Innovation Promotion Agency, AMTS, Agfa Healthcare, University Hospital Basel, Hightech Research Center of Cranio-Maxillofacial Surgery University of Basel and the University of Applied Sciences Northwestern Switzerland for their support of this study.

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