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Perspectives on Human-Computer Interaction and Culture

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- Linxen, S., Cassau, V., & Sturm, C. (2021). Culture and HCI: A still slowly growing field of research. Findings from a systematic, comparative mapping review. *Proceedings of the XXI International Conference on Human Computer Interaction*, 1–5. https://doi.org/10.1145/3471391.3471421
- Linxen, S., Sturm, C., Brühlmann, F., Cassau, V., Opwis, K., & Reinecke, K. (2021). How WEIRD is CHI? *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–14. https://doi.org/10.1145/3411764.3445488
- Pimmer, C., Linxen, S., Gröhbiel, U., Jha, A. K., & Burg, G. (2013). Mobile learning in resource-constrained environments: A case study of medical education. *Medical Teacher*, *35*(5), e1157–e1165. https://doi.org/10.3109/0142159X.2012.733454
- Pimmer, C., Linxen, S., & Gröhbiel, U. (2012). Facebook as a learning tool? A case study on the appropriation of social network sites from mobile phones in developing countries. *British Journal of Educational Technology*, *43*(5), 726–738. https://doi.org/10.1111/j.1467-8535.2012.01351.x
- Pimmer, C., Chipps, J., Brysiewicz, P., Walters, F., Linxen, S., & Gröhbiel, U. (2017). Facebook for supervision? Research education shaped by the structural properties of a social media space. *Technology, Pedagogy and Education*, *26*(5), 517–528. https://doi.org/10.1080/1475939X.2016.1262788
- Pimmer, C., Brysiewicz, P., Linxen, S., Walters, F., Chipps, J., & Gröhbiel, U. (2014). Informal mobile learning in nurse education and practice in remote areas—A case study from rural South Africa. *Nurse Education Today*, *34*(11), 1398–1404. https://doi.org/10.1016/j.nedt.2014.03.013

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Perspectives on Human-Computer Interaction and Culture

Abstract

Due to the global distribution of technology and its use in highly culturally diverse settings, an understanding of culture, in particular the connection between culture and technology use, is becoming more relevant for distributors and developers of such technology, in order to survive in a dynamic market environment and to be able to offer products that are tailored to the requirements of the specific end user. Therefore, the overarching topic of this thesis is the exploration of the role of culture in human-computer interaction (HCI) as a key factor to understanding the user.

This thesis sheds light on the role of culture and socio-cultural systems and their multi-layered manifestations in human-computer interaction. The related research consists of two main strands: The first strand (manuscript 1 and 2) focuses primarily on examining the extent to which national culture is considered in HCI studies, and the extent to which subjects from different national settings are part of HCI studies. The key findings of the first strand are that HCI research tends to neglect culture, or, if it is considered, it is mostly treated narrowly, as a single variable that measures national cultures. The restricted cultural perspective becomes further evident when studying the participant samples from the most relevant HCI conference. There was a strong focus on participant samples from countries whose inhabitants tend to be Western, educated, industrialised, rich and democratic (WEIRD) and most of the other countries were clearly underrepresented.

The second strand of this thesis (manuscript 3 to 6) centres on the examination of the relationship between HCI and cultural as well as socio-cultural systems, particularly in knowledge-intensive practices. It shows the rich practices of technology appropriation in study settings outside of the typical WEIRD contexts. Furthermore, it explores the manifold, rich and often complex ways in which the use of technology is impacted by structures and practices of cultural systems, and, in the same way, transforms these systems.

The results from both strands of enquiry show that the HCI community should consider the diversity of potential technology users in its research and recommendations. Only in this way can technological developments be realised that are globally useful and usable on a broad scale. To support the HCI community on this path, alongside suggestions for further research projects, this thesis presents several detailed recommendations on how to increase diversity and the consideration of cultural aspects in HCI research and the HCI community.

Contents

Introduction

Globalisation, internationalisation and technological developments, in particular in the form of mobile technologies and Internet access, allow companies to offer products and services both to local markets and to global buyers and user communities. In 2022, for example, the expected revenue in the global e-commerce market alone is approximately US$5.2 trillion and this is expected to increase by 56% to approximately US$8.1 trillion per year by 2026 (eMarketer, 2022). In addition to the rising revenue of the e-commerce market, the numbers reported by the social media world also illustrate the relevance and extent of global online markets. Currently, 4.7 billion people worldwide use social media (Kepios et al., 2022), with the four most used social media apps (We Are Social et al., 2022) alone accounting for a combined 8.95 billion active users per month (Facebook 2.91 billion, YouTube 2.56 billion, WhatsApp 2 billion, Instagram 1.478 billion). This development would not have been possible without an increase in Internet availability worldwide. Thus, in 2021, the number of Internet users increased to 4.9 billion people (ITU, 2021) and as a result, 63% of the world's population can currently access online content, products and services. Reasons for these positive developments are the increasing number of mobile phone user worldwide (5.34 billion in 2022 according to Kepios et al., 2022), worldwide coverage by mobile broadband networks, which are able to reach approximately 95% of the world’s population (ITU, 2021) as well as an estimated 4.67 billion active mobile Internet users worldwide (Statista, 2021b). Access to mobile Internet is particularly relevant in low- or middle-income countries (LMICs), where fixed broadband Internet subscriptions are limited. While the number of fixed broadband subscriptions is increasing worldwide (17 subscriptions per 100 inhabitants in 2021), fixed broadband in the UN-designated least developed countries (LDCs) remains the exception, with just 1.4 subscriptions per 100 inhabitants (ITU, 2021). However, in LMICs there are on average 103 mobile cellular subscriptions per 100 people (Worldbank, 2022) and, according to the ITU (2021), Internet penetration in Africa, Asia and the Pacific, as well as in the LDCs has increased on average by more than 20%. In Africa, for example, mobile Internet traffic is responsible for about 75% of all web traffic (StatCounter, 2022b) and Facebook with its 237.22 million users (Statista, 2021a) has the largest market share (over 80% in 2022) among social media platforms in Africa (StatCounter, 2022a). This general development in the form of convergence of social and mobile media has favoured the distribution of technologies in LMICs (Pimmer & Tulenko, 2016).

Due to the global distribution of technology (in the form of hardware and software) and its use in highly culturally diverse settings, an understanding of culture, especially the connection between culture and technology use, is becoming more relevant for distributors and developers of such technology in order to survive in a dynamic market environment and to be able to offer products that are tailored to the requirements of the specific end user. Therefore, the overarching topic of this thesis is the exploration of the role of culture in human-computer interaction (HCI) as a key factor to understanding the user.

The Concept of Culture in Human-Computer Interaction (HCI)

The concept of culture itself as well as the corresponding term is an extremely complex construct (Barber & Badre, 1998; Patel, 2013) that can be described and differentiated in many ways (e.g., subcultures, ethnic groupings). As early as the 1950s, Kroeber and Kluckhohn (1952) identified 164 different definitions of the term culture. One approach that has been used by several sociologists and anthropologists (see Table 1) is to describe the concept of culture by using a set of values and dimensions.

Table 1

Overview of Cultural Variables and Associated Authors

Variable	Author(s)
Environment Time Action	Kluckhohn and Strodtbeck (1961), Hall (1976)
Communication Space	Hall (1976)
Power Individualism Competitiveness Structure	Hofstede (1991), Hampden-Turner and Trompenaars (1993), Trompenaars and Hampden-Turner (2012)
Thinking	De Oliveira and Nisbett (2017), Witkin et al. (1977)

Note. Table based on C. Sturm (personal communication, May 24, 2022)

The dominant definition used in the social sciences (Kirkman et al., 2006) and also in culture-based HCI research (Clemmensen & Roese, 2010; Kamppuri et al., 2006; Linxen et al., 2021) is the one provided by Hofstede (1980). Hofstede (1980) describes culture as “the collective programming of the mind which distinguishes the members of one human group from another ... the interactive aggregate of common characteristics that influence a human group's response to its environment." (p. 25). In addition to the definition of culture, Hofstede identified five different cultural dimensions based on a large-scale survey of IBM employees from 53 countries and regions: Power distance, uncertainty avoidance, individualism versus collectivism, masculinity versus femininity and long-term orientation (see G. H. Hofstede et al., 2010 or; G. H. Hofstede & Bond, 1984 for a detailed introduction). Drawing on these identified dimensions of national cultures, Hofstede (1980; 1991) generated a framework that is still widely used in current HCI research decades after its creation (e.g. Alsswey & Al-Samarraie, 2021; Dhaundiyal et al., 2020; Faisal & Al-Qaimari, 2020) and which has led authors to derive design recommendations for the development of user interfaces (e.g., Ahmed et al., 2009; Marcus, 2005, 2009, 2010; Marcus & Gould, 2000; Sheridan, 2001). However, these design recommendations have been critically questioned (e.g., Hsieh et al., 2009; Jagne & Smith-Atakan, 2006) and Hofstede's framework has also been criticized by various research fields (e.g., Jones, 2007). Criticisms refer to a simplification of cultural differences and an inflexible cultural model (Signorini et al., 2009), a "philosophical flaw" in the fifth dimension (Fang, 2003), the representativeness of the survey samples and that nations are not a valid unit of analysis (McSweeney, 2002) and that globalisation is leading to an increasing fluidity in the nature of culture (Nakata, 2009).

According to Reinecke (2010), culture in HCI is often associated with a nation and thus with national borders. However, the artificial and political borders of a nation and the global exchange of people and information (Reinecke, 2010) as well as - with regard to Hofstede's cultural dimensions - the use of the "tendency towards the average" and the lack of attention to subcultures (McSweeney, 2002) within national borders suggest that the validity of this approach can be questioned. Consequently, voices in the HCI community are increasingly calling for a more granular approach. For example, Schlesinger et al. (2017) highlights the importance of detailed attention to user identity and a detailed description of it in order to recognize how "identity intersects with technology" and presents recommendations to optimise the representation of user identity in HCI studies.

Localisation According to Cultural Characteristics

The predominant way to consider culture during the development of HCI systems is to adapt a product to a local user group. During the development of a product, be it hardware or software based, developers have various options and stages at their disposal to align a global product with an international target group and thus different markets. One of the most relevant approaches is that of localisation (see Esselink, 2000; or W3C, 2005 for an introduction). According to the Localization Industry Standards Association (2003), localisation involves all steps taken to adapt a product or service to differences and needs in diverse markets, taking into account linguistic, technical, content and cultural issues.

The localization of a technology, be it hardware or software, is usually based on the geographical boundaries of a nation. The HCI community supports this process with research projects (e.g., Alsuhaibani et al., 2018; Gasparini et al., 2011; Wang et al., 2022) along with recommendations and guidelines (e.g., Esselink, 2000; Ferreira, 2017; Jakovlev, 2020; Jiménez-Crespo, 2013; Marcus & Gould, 2012; Ortinau et al., 2021). The results generated typically use country classifications as a framework to distinguish between user groups. In this context, the country and the associated geographical definition are usually used as synonyms for culture in order to enable comparability and measurability between different (national) cultures (Reinecke, 2010). Hofstede's framework (1980; 1991) has very often been used to guide culture-specific technological design (Ahmed et al., 2009; e.g., Marcus, 2005, 2009, 2010; Marcus & Gould, 2000; Sheridan, 2001).

Cultural Appropriation of Technology

A second way to explore the relationship between HCI and culture is to examine the ways in which technology is being used differently in diverse cultural systems. This is known as appropriation, which can be understood in contrast to the concept of adoption. According to Gao and Krogstie (2016, p. 1517), technology adoption is "the choice to acquire and use a new innovation" and can therefore include not only a new technical product, but also innovative services or management methods (Forman et al., 2018). According to Wirth et al. (2008) the process of technology adoption draws on the tenets of diffusion theory: it is binary in nature and focuses on the question of whether a technology has been adopted or not. However, regarding the concept of adoption, Forman et al. (2018) highlighted the importance of co-invention as described by Bresnahan and Greenstein (1996). A process following

adoption that involves adaptations and additionally developed processes related to the adopted technology in order to increase its level of usefulness. Similar viewpoints are addressed and expanded by the concept of appropriation. In contrast to pure adoption, appropriation is based on a deeper understanding of the specific ways in which a technology is used (Wirth et al., 2008). The process of appropriation describes how "technology or technological artefacts are adopted, shaped and then used" (Carroll et al., 2002, p. 1778) and, according to Cook and Pachler (2011), how technologies and their artefacts are not only used within the framework intended by the developer, but are appropriated by the user and adapted for their own purposes and requirements. This appropriation of technology manifests itself in three "non-linear, cyclical and recursive" stages in a socio-cultural context (J. Cook & Pachler, 2011). These three stages include (1) the exploration of new technologies (e.g., features, scope of use) and (2) the incorporation of technologies into everyday life as well as (social) application practices of users (adaptation, accommodation, and assimilation). The last stage (3) describes change, in the sense of adapting existing practices (personal and social) and pushing boundaries in the existing socio-cultural space, based on the possibilities of the appropriated technology. Therefore, the concept of appropriation can not only be used to explore in detail the relationship between HCI and culture, but can also be considered as a measure of technology acceptance by users (Dix, 2007).

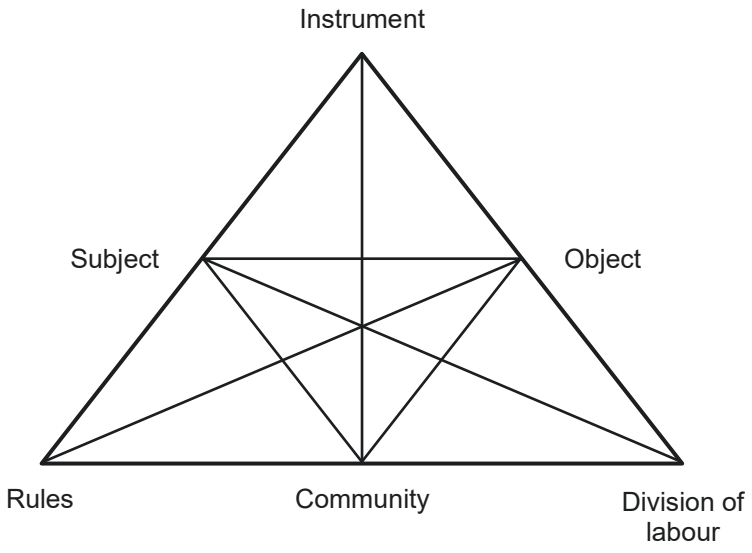
Technology and the Transformation of Cultural Systems

A third approach is to explore how technology use can impact and possibly transform cultural systems. In contrast to appropriation, technology use is not only shaped by cultural systems. Instead, the relationship should be understood as recursive. When considering change in a technologically-mediated cultural system, the notion of such a system needs to be clarified. As emphasised above, it is necessary to consider cultural systems from a perspective where geographical (political) features are not the only defining variable. This is because a national culture can consist of many highly distinct subcultures and at the same time, cultural systems - in particular, mediated cultural systems such as online communities - bring together people from diverse national and regional backgrounds. These cut across national boundaries - as could also be shown in this thesis (see Summary of Manuscript 4). The concept of socio-cultural (and not exclusively cultural) systems is often used because many systems are inextricably social and cultural in nature. They are conceived in terms of (cultural) meanings and behavioural norms, and these meanings and norms are tied to social relationships and institutional contexts (Kleinman, 1978). There is, however, no commonly-agreed definition of cultural or socio-

cultural systems. For example, drawing on Elwell (2013), socio-cultural systems consist of three types of phenomena: material (e.g., physical environment, populations, and technologies used), social structural (groups and organisations such as government, economic and family systems), and ideational (e.g., values, norms, ideologies and religious faith). Another popular approach to describing and analysing cultural systems – also in the field of HCI research (Kaptelinin & Nardi, 2006) - is the cultural historical activity approach which is based on the works of Vygotsky (1978) and Leontiev (1978, 1981) and is further expanded by Engeström (1987, 2001, 2015). Engeström (2001) characterises a cultural historical activity system by the interplay of subjects, mediating artefacts (in terms of instruments or tools), objects, rules, community and the division of labour (see Figure 1). McAvinia (2016) describes these interactions as follows: A subject pursues an object (which is the motivation for the activity). In this context, mediating artifacts (instruments/tools) are used. A further mediating influence includes community, the rules (e.g., laws, tacit agreements) of that community, and the division of labour.

Figure 1

Illustration of an Activity System Based on Engeström (1987, 2015)



In a simplified example (based on Varpio et al., 2008), an activity exists in which a physician (subject) pursues the goal of providing good patient care (object, which in this case is considered as an objective) and uses certain drugs (tools/instruments) to do so. However, other factors also influence this activity. Thus, the physician is a member of one or more groups (communities), such as a ward or a group of experts. There is a division of labour between these groups, and a definition of which tasks the

physician (e.g., determining the dose of medication), the nurses and other members are responsible for. Furthermore, rules (overt or covert) exist, e.g., which medication the doctor can prescribe and under which circumstances.

These six elements of an activity system have often been used in a descriptive analytical effort to explore complex systems. Importantly, activity systems are not rigid and closed systems, but can often be changed by occurring contradictions and their effects (Engeström, 2001; V. Wilson, 2014). Thus, the activity system approach also describes how the introduction of technology (or a new instrument) to a system can trigger contradictions which result in tensions between system elements, and these tensions can ultimately lead to the transformation of the system over time (Engeström, 2001, 2015). Engeström (2001) also stated that activity systems are characterized by "multi-voicedness", which means that due to the community and the division of labour, participants with different backgrounds and interests interact with and in a system that has its own rules, history and conventions. These numerous influencing factors can also lead to possible conflicts as well as innovations. In this way, individual members of the activity system can question existing rules and begin to soften established structures. This can ultimately lead to an existing system being changed through collectively supported activities.

Following the tenets of this introduction, the thesis consists of two main strands: In the first strand (manuscripts 1 and 2), the main analytical focus is on the investigation of the extent to which national culture is considered in HCI studies, and on the extent to which subjects from different national settings are part of HCI studies. The second strand (manuscripts 3 to 6) centres on how users in different cultural systems appropriate technology; and on the ways in which technology use is, in turn, shaping and transforming these systems. For the second strand, the focus is on the use of knowledge-intensive practices, that is, learning, collaborating and knowledge sharing from the Asian and African contexts.

Overview of Manuscripts Included in This Thesis

The following six manuscripts provide the foundation for this thesis. All articles listed have already been published. The first two manuscripts shed light on the extent to which the aspect of the (national) culture and cultural diversity of research subjects is taken into account within the usual scope of HCI research. Manuscript 1 addresses the question of whether and how often (national) culture is an object of study in seven high-profile HCI research publication formats and how this evolved over two main time periods (1990-2005 and 2016-2020). Drawing on and expanding the findings of the limited consideration of culture as a construct, the second study explores the national/cultural origins of the participant samples examined for the studies at the most renowned (ACM, 2022) and quoted (Google Scholar, 2022) conference in the field of HCI, the ACM CHI Conference on Human Factors in Computing Systems. It also addresses the question of whether these participant samples are primarily from WEIRD countries, that is, countries whose inhabitants tend to be Western, educated, industrialised, rich and democratic.

1. **Linxen, S**.*, Cassau, V., & Sturm, C. (2021). Culture and HCI: A still slowly growing field of research. Findings from a systematic, comparative mapping review. *Proceedings of the XXI International Conference on Human Computer Interaction*, 1–5. https://doi.org/10.1145/3471391.3471421

2. **Linxen, S.**, Sturm, C., Brühlmann, F., Cassau, V., Opwis, K., & Reinecke, K. (2021). How WEIRD is CHI? *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–14. https://doi.org/10.1145/3411764.3445488

* Sebastian Linxen and Christian Sturm contributed equally to this research.

The second strand of work sheds light on the multi-faceted relationships between HCI and cultural and socio-cultural systems. In showing the complex interdependencies of culture and technology use in the field of knowledge-intensive practices in Asian and African contexts, it further underpins the relevance of the study of cultural aspects, which, in many respects, has been neglected to date. Manuscripts 4 to 6 illustrate these observations by showing various studies and examples of changing activity systems in different cultural and professional contexts as well as in different technological settings.

Studying the use of technology by medical students in Nepal, manuscript 3 demonstrates the introduction of technologies to an existing activity system and shows how the connected appropriation of these can lead to significant tensions and subsequent changes within that cultural system. The analysis shows specifically how learners appropriate mobile and social media-based learning technologies.

Manuscript 4 examining a similar context and illustrates how a media platform (in this case a Facebook site) is used by medical students, doctors, and patients as a rich and "massive" space for learning and knowledge exchange. In so doing, it serves as a boundary object, connecting elements from a range of diverse socio-cultural systems.

Manuscript 5 examines another case of technology appropriation in the context of research supervision of nurses in South Africa. The study focusses on the ways in which Facebook was used by supervisors to support and guide a group of research students. A key finding is the revealing of the complex ways in which the integration of different cultural systems (academic / professional cultures and social networking cultures) caused tensions, and how the use of the platform is shaped by learners and supervisors negotiating these tensions.

Also in the South African context, manuscript 6 illustrates and examines the ways in which nurse practitioners and students' appropriate digital technologies, especially mobile and networked media, for informal and situated learning purposes to provide cognitive and socio-emotional support. In this paper too, changes in the socio-cultural system caused by the appropriation of a new tool led to tensions which needed to be addressed (e.g., by introducing new or adapted activities).

3. Pimmer, C., **Linxen, S.**, Gröhbiel, U., Jha, A. K., & Burg, G. (2013). Mobile learning in resource-constrained environments: A case study of medical education. *Medical Teacher*, *35*(5), e1157–e1165. https://doi.org/10.3109/0142159X.2012.733454

4. Pimmer, C., **Linxen, S.**, & Gröhbiel, U. (2012). Facebook as a learning tool? A case study on the appropriation of social network sites from mobile phones in developing countries. *British Journal of Educational Technology*, *43*(5), 726–738. https://doi.org/10.1111/j.1467-8535.2012.01351.x

5. Pimmer, C., Chipps, J., Brysiewicz, P., Walters, F., **Linxen, S.**, & Gröhbiel, U. (2017). Facebook for supervision? Research education shaped by the structural properties of a social media space. *Technology, Pedagogy and Education*, *26*(5), 517–528. https://doi.org/10.1080/1475939X.2016.1262788

6. Pimmer, C., Brysiewicz, P., **Linxen, S.**, Walters, F., Chipps, J., & Gröhbiel, U. (2014). Informal mobile learning in nurse education and practice in remote areas—A case study from rural South Africa. *Nurse Education Today*, *34*(11), 1398–1404. https://doi.org/10.1016/j.nedt.2014.03.013

Summary of Manuscript 1: Culture and HCI: A Still Slowly Growing Field of Research. Findings From a Systematic, Comparative Mapping Review

Aim of the Study and Motivation. Various studies have shown that the perception and use of technology can differ depending on the user's national cultural background (e.g. Cho et al., 2018; Dong & Fu, 2010; Song et al., 2019). For example, efficiency in searching on websites (Baughan et al., 2021) and ratings of subjective usability (Sauer et al., 2018) may differ depending on the national culture of the participant samples. Based on these results, this influencing factor should be considered during the planning and development process of human computer systems. As early as 2006, Kamppuri et al. investigated the relevance and frequency of (national) culture-related publications in selected HCI publication formats and discovered that only 0.9% of the studies reviewed focused on (national) culture. The goal of the present study was to follow up on the work of Kamppuri et al. (2006) and to analyse the current situation and determine the development and current status of culture-based research in the major HCI scientific outlets'.

Method. To achieve this goal, we carried out a systematic, comparative mapping review. In a first step we conducted a systematic quantitative content analyses of 5669 full articles from the following seven major HCI journals and conference proceedings in 2010, and from 2016 to 2020: (1) Human-Computer Interaction (JHCI, 2021), (2) International Journal of Human-Computer Interaction (IJHCI, 2021), (3) International Journal of Human-Computer Studies (IJHCS, 2021), (4) Interacting with Computers (IWC, 2021), (5) ACM CHI Conference (CHI, 2021), (6) Behaviour & Information Technology (TBIT, 2021) as well as (7) ACM Transactions on Computer-Human Interaction (ToCHI, 2021).

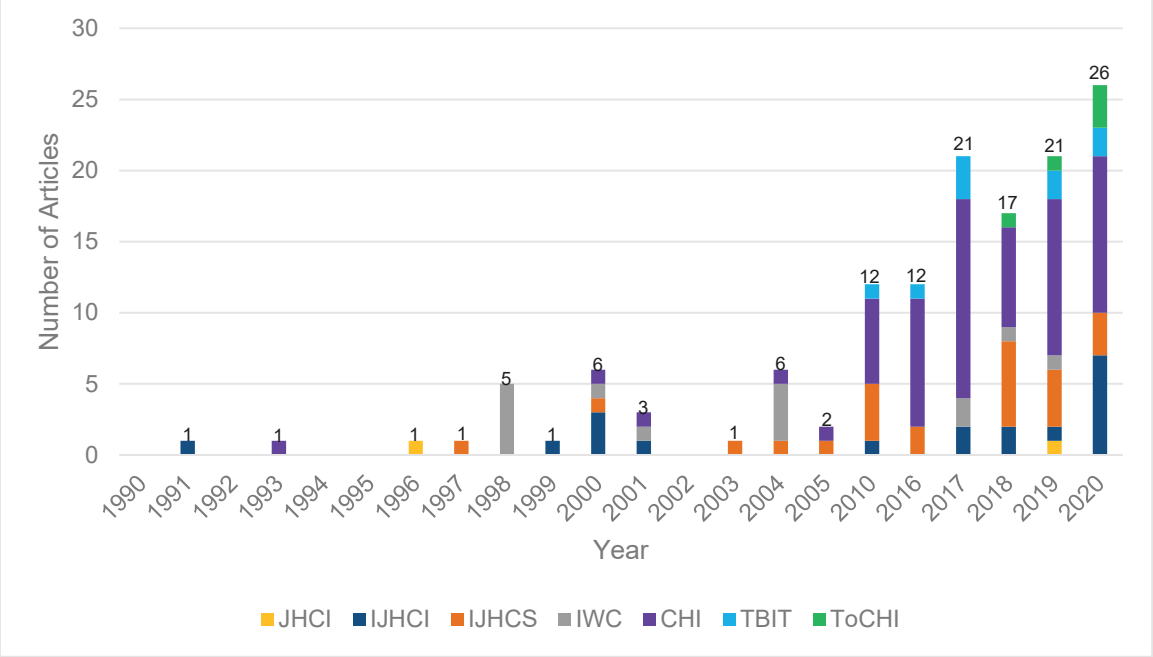
We examined (a) how frequently articles addressed (national) culture as a research topic. In addition, 5% (n=284) of the articles of the total sample were randomly selected and rechecked to ensure data quality and consistency as well as to analyse the inter-rater reliability. A determined inter-rater agreement of 98% indicated a low level of subjectivity. This approach resulted in a dataset of 109 culture-related articles (1.9% of the original sample), which were included for further analysis. For these 109 papers we then identified categories such as (b) countries studied and (c) sources of cultural theories and underlying definitions using an adapted coding scheme drawn from the study by Kamppuri et al. (2006). To improve the reliability of the data gathered, we applied inductive principles of qualitative data analysis (Pope et al., 2000) and discussed variations in the results of the data analysis until agreement was reached.

In a second step our findings were systematically compared to those reported in the study by Kamppuri et al. (2006), which was similarly structured. The work of Kamppuri et al. (2006) examined the "occurrence and characteristics of the studies of culture in HCI", covering a 16-year time span (1990-2005), including publication formats 1-5 and observing a total sample of 3286 articles, which included 28 (0.9%) (national) culture-related studies. This approach and the selected time spans allowed us not only to examine the current status with regard to the consideration of cultural aspects as well as present trends and developments (between 2016 - 2020) in the most important HCI publication formats, but also to examine developments over a longer period of time, by comparing our findings with Kamppuri et al. (2006) results. By analysing publications from 2010, we were able to take a snapshot of developments that took place between 2005 and 2016, allowing us to assess the overall trend.

Results. With regard to the (a) frequency of studies that addressed (national) culture we observed that during the study period of 2010 and 2016-2020, only 109 (1.9%) of 5669 articles addressed (national) culture. Nevertheless, we were able to show that the number of articles increased overall in the period we considered (see Figure 2).

Figure 2

Culture-Related Articles per Year and Publication



Note. The underlying data are based on the study by Kamppuri et al. (2006), who examined the period from 1990 to 2005, and the authors' own analyses covering 2010 and the period from 2016 to 2020.

The high number of publications at the CHI, which is considered the most prestigious conference in the field of HCI (ACM, 2022), is striking. Of the 109 culture-related articles, 58 (53.21%) were published at the CHI. However, when publications are considered in relation to the total number of articles published by a publication medium (see Table 2), it appears that the IJHCS most frequently examined (national) cultural aspects, with 3.7% (n=19) of all its publications, compared to only 1.6% (n=58) of all articles published by the CHI.

Table 2

Overview of all Published Articles by Number (Total and Culture-Related) and Percentages of Culture-Related Articles

Journals and proceedings	$n_{papertotal}$	$n_{paperculture}$	$\%_{paperculture}$
JHCI	78	1	1.3
IJHCI	582	13	2.2
IJHCS	513	19	3.7
IWC	244	4	1.6
CHI	3571	58	1.6
TBIT	479	9	1.9
ToCHI	202	5	2.5
Total	5669	109	1.9

In the 16-year period (1990-2005) studied by Kamppuri et al. (2006), only 0.9% (n=28) of 3286 articles addressed culture-related topics. In the 6 years we studied (2010 and 2016-2020), the same scientific outlets published 95 relevant articles. It is interesting to observe the shift in the publication volumes of the outlets in the studied time periods. Between 1990 - 2005, the IWC published the most culture-related articles (n=11) while the CHI published only 5 articles in this area. However, the ratios reversed in the period we studied. Here, the IWC published only four culture-related articles and only the JHCI published fewer (n=1). In contrast, the CHI was responsible for 53.2% (n=58) articles in the overall sample.

A further focus of the analysis was (b) the coverage of countries in the culture-related articles. While a total of 24 countries could be identified in the analysis phase of the Kamppuri et al. (2006), this number had already risen to 44 (out of 84 articles) in the period we examined. A change could also be

observed in the distribution of the most frequently examined national cultures. In both study periods, the US was the most studied national culture. However, during the study period of 2010 and 2016-2020, it was found that the origin of the research participants was distributed more broadly. From 1990-2005, a total of 95.6% of the participant samples could be assigned to the four most frequently studied cultures, whereas the data gathered in our study period showed that "only" 45% of the participants could be assigned to the top four national cultures (see Table 3). On a positive note, during that period, 32 articles (38.1%) examined more than one (national) cultural population, which also leads to a higher number of participant samples.

Table 3

Top Four of Most Frequently Covered Countries in Both Study Periods

Study period	1990-2005			2010, 2016-2020		
	Country	$n_{participant\ samples}$	$\%_{participant\ samples}$	Country	$n_{participant\ samples}$	$\%_{participant\ samples}$
No.						
1	USA	10	41.6%	USA	34	21.4%
2	China	5	20.8%	China	17	10.7%
3	Japan	4	16.6%	Great Britain	12	7.5%
4	Germany	4	16.6%	South Korea	9	5.7%

A further research focus included the usage of literature-based definitions of the concept of culture in the articles of the selected samples. It became evident that in both study periods, a large number of articles used the term as well as the concept of culture but did not present a corresponding theory or concept. In the study period of Kamppuri et al. (2006), the proportion of these articles was 40% (n=11) and in our study window it increased to 45% (n=50). Among the articles that defined a cultural framework, Hofstede's definition presented in his work “Cultures and Organizations: Software of the Mind” (G. H. Hofstede, 1991; G. H. Hofstede et al., 2010) dominated in both study periods. In addition to Hofstede's definition, theoretical underpinnings were also found with definitions originating from the management context or from post-colonial theories. In many of the articles analysed, the concept of culture was directly related to nationality, but in the study period 2010 and 2016-2020, it was noticeable that other characteristics than nationality were now being included in the concept of culture.

Discussion and Conclusions. With regard to the development and current status of culture-based research in the major HCI scientific outlets, it could be shown that the HCI community, showed a slightly increased interest in addressing ethnic and cultural aspects. Compared to the study period 1990-2005, the number of articles addressing (national) cultural aspects increased from 0.9% to 1.9% in our studied time period. This slightly positive trend is further supported by the existence of specialised conferences, such as the ICTD (2021), or organisations, such as HCIXB (2021), where culturally relevant research can be published and discussed.

A positive development is that a larger number of different nationalities were studied during our analysis period and that their geographical distribution was more even. Nevertheless, only a few countries still accounted for a substantial number of the participant samples. This means that a generalisation of the study results is limited. The HCI community should therefore continue to increase the cultural diversity of the participants.

The large number of articles analysed in both study periods that refrained from a theoretical discussion of the term and concept of culture is unusual for scientific work. This finding could be explained by the complexity of the concept of culture, as various research fields and disciplines offer different definitions. Alternatively, a simplistic approach to the concept of culture is being taken, as it is assumed to be common knowledge and culture is often considered as a purely national concept. In both cases, the unavailability of a definition prevents an in-depth examination of the subject matter and hinders the development of the research field.

Due to our comparative analysis and our orientation towards the methodology of Kamppuri et al. (2006), we only examined articles in which the title, abstract, or keywords included the terms "culture" or "cultural". This created the possibility that studies were excluded that addressed cultural aspects but did not clearly state them as such. Accordingly, future work seeking similar analyses should broaden the search criteria used in order to gather a more comprehensive picture of the current research situation. In addition, articles that include cultural aspects or cross-cultural studies should pay attention to consistent labelling to support potential categorisation and evaluation.

Summary of Manuscript 2: How WEIRD is CHI?

Aim of the Study and Motivation. The ACM CHI Conference on Human Factors in Computing Systems (CHI) is considered the most influential conference in the field of human-computer interaction (CHI, 2019b) , and its publications influence the design and development of technological innovations. These technologies are generally used worldwide but are conceptualised and developed in Western technology hubs by people who tend to be arguably Western, educated, industrialised, rich, and democratic or, in short, WEIRD. However, several studies show that perceptions and use of technology may differ by culture and country (e.g., N. Oliveira et al., 2016; Reinecke et al., 2013). For instance, a person's country of origin may influence their engagement with a MOOC (Guo & Reinecke, 2014) or their use of smartwatches (Dutot et al., 2019). This means that HCI studies should not only recruit participants from the WEIRD context, but also use diverse participant samples in order to develop globally useful and usable products. The CHI Community and SIGCHI Executive Committee are already making an effort to "foster HCI growth around the world" (Mentis et al., 2018) and to increase international diversity, with initiatives such as HCI Across Borders (Kumar et al., 2016) or RepliCHI (M. L. Wilson et al., 2012). To support these efforts and to analyse the current international diversity of CHI participant samples we have formulated the following two main research questions:

- Research question 1: To what extent are participant samples in CHI papers from Western, educated, industrialised, rich or democratic societies?
- Research question 2: Which countries are over- and understudied?

Method. In order to answer the research questions outlined above, a systematic quantitative content analysis of the conference proceedings of the CHI Conference on Human Factors in Computing Systems of the period 2016 to 2020 (CHI, 2016, 2017, 2018, 2019a, 2020) was conducted. This sample included 3,269 articles. CHI was selected on the basis of its great relevance for the CHI community (CHI, 2019b) and its high impact factor (Google Scholar, 2020), in addition to a high citation frequency (ACM, 2020; Google Scholar, 2020). The chosen 5-year period of analysis allowed us to capture the development over time and to take into account the influence of different conference venues.

For our analysis we selected the WEIRD acronym introduced by Henrich et al. (2010) to determine if and to what extent participants samples of CHI studies tend to be from Western, educated, industrialised, rich and/or democratic countries. Furthermore, this approach allows a comparison with

similarly-structured studies in other research fields (e.g. Arnett, 2008). For our analysis the WEIRD concept was operationalised as follows:

- **W**estern: The countries of origin of the participant samples in the studies were extracted from the method sections of the articles and categorised as Western and non-Western. Western was defined as countries that either were part of the European Union (2020) or matched Huntington's (2011) classification for Western countries.
- **E**ducated: The educational level of the actual study participants was extracted from the articles whenever possible and converted to the International Standard Classification of Education system (ISCED) (UNESCO Institute for Statistics, 2012). Furthermore the mean number of years of schooling per person per country was used (Ministry of Education, 2020; United Nations Development Programme, 2019) to identify differences in the average educational level.
- **I**ndustrialised: The gross domestic product per capita (GPD, PPP, Int$) (The World Bank Group, 2020a) was used as an indicator of a country's level of industrialisation. This parameter provides the most meaningful assessment of the development of a country's economy (Lepenies, 2016).
- **R**ich: To obtain information on the average wealth of the participant samples, we used gross national income per capita (GNI, PPP, Int$) (The World Bank Group, 2020b), and also extracted figures on personal income, if this information was included in the analysed articles.
- **D**emocratic: To assess the degree of democratic development in the countries of origin of the participant samples, we used the analyses and figures of the political rights rating (Freedom House, 2020).

In order to extract the required information manually from the articles, a coding scheme was developed, tested on 100 randomly-selected articles, and then transformed into a revised version (see Table 4). Since an automated extraction of the variables is very difficult due to linguistic and structural differences in the articles, a manual analysis approach was chosen. One author subsequently analysed 3,269 articles of the total sample and excluded 501 articles that did not report on a human subjects study. This resulted in a final data set of 2,768 articles. To check for data quality, inter-rater effects, and data consistency, 139 randomly selected articles (5% of the total sample) were also analysed by a second author. An "almost perfect" value (Landis & Koch, 1977) of $\kappa = 0.947 – 0.986$ ($p < .001$), 95% CI (0.87 – 0.98, 1.00) regarding inter-rater reliability indicated little subjective influence variables in the data analysis.

Table 4

The Coding Scheme Used to Extract Variables of Interest From all CHI Papers Between 2016-2020

Focus	Variable
General information	Title, year of publication
Method	Study method
Author information	Name, place of affiliation, affiliation
Participant information	Place of residence, education, income

To determine whether a country is over- or under-represented at the CHI compared to its population size (research question 2), the number of participants and participant samples was established in relation to the real population numbers (provided by United Nations, 2019). This normalisation by country population resulted in two values per country: ψ_p – participant ratio and ψ_s – participant samples ratio. Here, a value below 1 indicated that a country was underrepresented and a value above 1 indicated that a country was overrepresented.

With regard to parts of research question 1, namely to what extent participant samples of the CHI tend to be from educated, industrialised, rich or democratic countries the value ψ_s was correlated with the previously presented parameters (e.g., mean years of schooling, GDP, GNI).

Results. Of the 2,768 articles that included a human subject study, 1,692 had to be excluded from further analysis. One reason for this was the absence of data on the number of participants in a study (5.7% of the articles) as well as missing information on the origin of the participants in the studies (61.1% of the articles). In the end, only 1,076 papers (38.9%) met these conditions and could be considered for further analysis.

Addressing research question 1, the majority of studies at the CHI were conducted with Western participant samples (see Table 5). 73.13% (n=1,102) of the participant samples originated from 31 Western countries. However, over the study period of 2016 - 2020, a slight decrease in the number of Western participant samples (from 83.69% to 69.76%) and nearly a doubling of non-Western participant samples (from 16.31% to 30.24%) could be identified. In parallel, a significant decrease in the number of US participant samples was observed. The highest recorded percentage of participant samples from the US was 43.56% in 2018 and this gradually dropped to 24.84% in 2020. These figures indicate that

studies are also more frequently analysing participant samples from more than one country and that study participants from countries other than the U.S. are gaining importance. This analysis also identified the research technologies used and the relationship between the authors' place of affiliation and the participant samples' country of origin. It was found that the studies with the most participants as well as the most diverse participants often used online and/or behavioural log data studies and that more than 80% of the authors recruited participants samples in their countries of origin.

Table 5

Distribution of CHI Western and Non-Western Participant Samples

	Samples			
Variable	n	%	M_{ψ}	Mdn_{ψ}
Western	1,102	73.13	5.92	5.72
Non-Western	405	26.87	1.62	0.45
Total	1507	100		

Note. A single paper can report multiple samples. M_{ψ} shows the average ratio and Mdn_{ψ} represents the median.

Regarding the under- or over-representation of a country at the CHI (research question 2), the results indicate that Western countries are over-represented not only in terms of the actual number of study participants, but also in terms of participant samples compared to the world's population. In fact, participants from the United States alone account for 54.84% of all study participants in CHI studies, yet the United States only accounts for 4.25% of the world's population (accordingly, this leads to a high ratio of ψ_P=12,91).

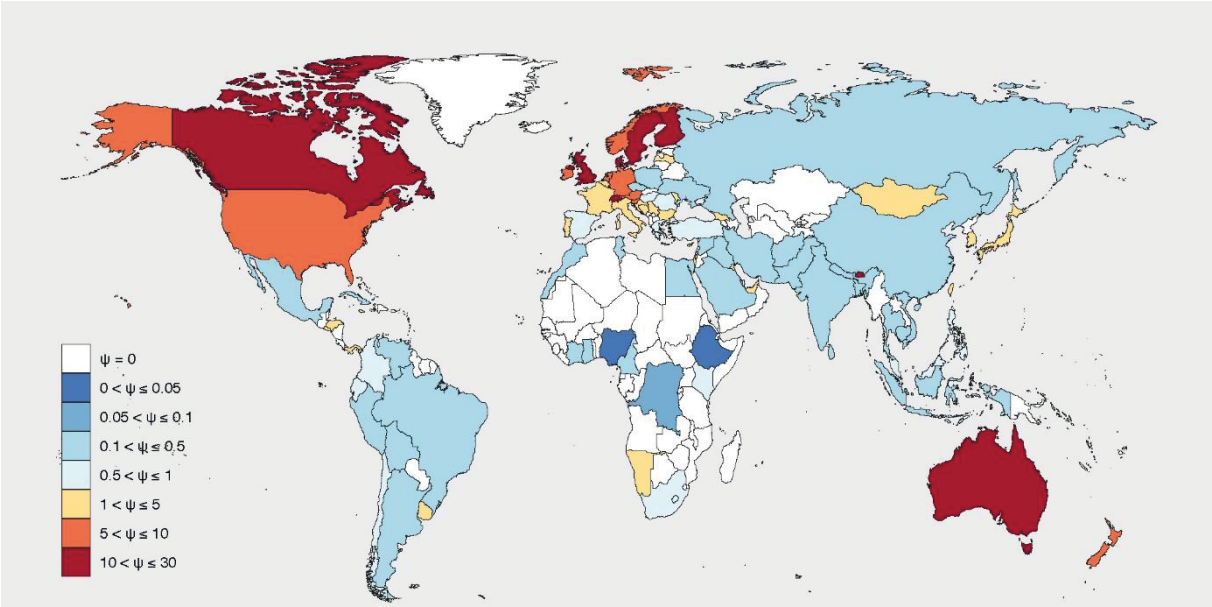
Looking at the number of participant samples, the top four countries (out of 93) represent the "Western" category and account for almost 78% of all participant samples (USA=45,82%, Great Britain, 15,71%, Germany=8,74%, Canada=7,62%).

By sorting the participant samples according to the participant sample ratio, it becomes clear that smaller European countries in particular provide the most participant samples at the CHI in comparison to their population size and are therefore strongly over-represented. In the top 10, countries such as Finland, Denmark, Sweden, Luxembourg, Switzerland, and Great Britain have a score (ratio ψ_S) between 10.76 and 16.80.

An examination of the geographical distribution of the participant samples relative to their population reveals that a high number of countries are not considered in CHI studies (see Figure 3). During our study period, 93 countries provided participant samples for study. This means that 102 (52%) of 195 countries (based on United Nations, n.d., 2015) were not represented with a single study participant in CHI articles. The countries that are not taken into account are primarily found in Africa, but also in the Middle East, Central and South Asia, Europe as well as Central and South America.

Figure 3

Worldwide Distribution of CHI Participant Samples Ratio (ψ_s) Between 2016-2020



Note. This map indicates which countries are over-represented ($\psi > 1$) or under-represented ($\psi < 1$), relative to the world's population. Countries coloured white did not have a single study participant in the analysed CHI proceedings.

With regard to research question 2, we were able to show the strong Western orientation of the CHI participant samples and that they tend to come from highly educated, industrialised, rich, and democratic countries (see Table 6). In addition to the calculated correlations, we also extracted information from the methods sections of the articles for the "educated" and "rich" variables. While no analysis could be drawn on the wealth of participants due to inconsistent data in the articles, it was found that approximately 70% of study participants were college-educated (based on 24% of articles providing sufficient data on the educational level of their participants).

Table 6

Kendall Rank Correlations of the Participant Samples Ratio ψ_s With Measures of Educated, Industrialised, Rich, Democratic

	Samples		
Variable	r_T	95% CI r_T [LL, UL]	$n_{country}$
Educated	.46***	[.341, .593]	93
Industrialised	.50***	[.397, .624]	91
Rich	.50***	[.386, .623]	90
Democratic	.50***	[.381, .619]	93

*Note. $n_{country}$ differs due to available data per country. LL and UL indicate the lower and upper limits of a bootstrapped confidence interval (10,000 replicates). Significance levels: *p <.05, **p <.01, ***p <.001.*

By examining the data with respect to the extent to which CHI participant samples were from countries that met all five WEIRD factors (when the greater than median value was used as the cut-off for EIRD), we were able to show that of a total of 1,502 participant samples, 1,070 (73.13%) qualified as fully WEIRD.

Discussion and Conclusions. Our study showed that participant samples of CHI publications are not representative of the world's population. 73% of findings or CHI studies are based on Western participant samples and 97% of these tend to be from countries where all five WEIRD variables can be applied. In addition, more than half of all countries in the world (102 out of 195) are not covered by CHI research studies. This means that we have little or no information about the technology usage of users in these countries and that almost three quarters of the knowledge we produce at CHI is based on roughly 12% of the world's population. We were also able to demonstrate that small Western countries were often strongly overrepresented at the CHI compared to the size of their country's population. Furthermore, we could show that the majority of CHI participant samples tend to be from countries that have a highly educated population, are industrialised, rich, and democratic.

However, we were also able to identify positive developments. We found increasing diversity in the geographic distribution of CHI participant samples. In fact, over the 2016-2020 period, the number of non-Western participant samples doubled to nearly 30.24%. The parallel reduction of Western-

participant samples is shown clearly by the decline in the number of US participant samples. Over the analysis period, these fell by almost 13% to 24.84% by 2020. These results can be explained to some degree by the different conference venues, but also by SIGCHI's efforts to increase the diversity of authors and study participants. In addition, the use of online studies and the resulting simplified access to international participants may have contributed to these developments. These factors, as well as research fields such as HCI4D or ICTD and studies conducted in Western countries with groups of people who have low income or education (e.g., Dillahunt & Hsiao, 2020; Dombrowski et al., 2017; Harrington et al., 2019; Vines et al., 2014) allow the CHI community to observe differences in usability and usage of technology in diverse populations.

Based on our findings, we developed several ideas to make CHI less WEIRD (a-d). (a) Based on the observation that authors often recruit local participants, author teams from non-WEIRD and WEIRD countries would be helpful to diversify participant samples. (b) Increasing the number of online studies would also increase access to diverse participant samples. (c) Replications of influential studies in a cross-cultural context should be fostered to identify any relevant differences in technology usage and usability in a culturally relevant context. Lastly, given that 56% of the articles in our sample did not include information on the country of origin of the participants, (d) papers at the CHI should increasingly provide such information, not only to enable replications and meta analyses, but also to track the diversity of participant samples.

The presented study was authored by individuals who are all associated with the WEIRD context; therefore, this influenced the ideas formulated above as to how the CHI could become less WEIRD. Future work should challenge and expand these ideas and perspectives as well as analyse which of the ideas may affect the diversity of participant samples and to what extent. In addition, a similar examination of related conferences (e.g., CSCW, 2021) and journals (e.g., TOCHI, 2020) would also be relevant in order to provide a more complete picture of the situation in the HCI community.

Summary of Manuscript 3: Mobile Learning in Resource-Constrained Environments: A Case Study of Medical Education

Aim of the Study and Motivation. The potential and use of information and communication technology (ICT) in medical education in Western countries has been widely studied and is considered a useful and effective complement to traditional educational approaches (D. A. Cook et al., 2008; Harden, 2006; Wutoh et al., 2004). The role of ICT in health and education is seen as crucial, especially in developing countries and expectations are correspondingly high (Chandrasekhar & Ghosh, 2001; World Bank, 2011). For example, ICT can have a positive impact on the training and practice of health workers in developing countries (Pakenham-Walsh et al., 1997), but the use of technology is constrained by various factors. These may include inadequate media literacy (Ajuwon, 2003; AlGhamdi, 2009; Samuel et al., 2004) or insufficient IT infrastructure (Chandrasekhar & Ghosh, 2001; Kommalage & Gunawardena, 2008; Williams et al., 2010). However, there is little literature-based information on how technology can promote learning in resource-limited settings and the impact this has on medical education in developing countries. Therefore, the purpose of this study was to examine the use and impact of educational technology in medical education in a resource-limited setting. Cultural-historical activity theory functioned as an analytical framework, as it allows for the analysis of changing systems and the learning associated with them. This theory is frequently used in scientific research examining technology-enhanced learning and the use of ICT (Blin & Munro, 2008; Isssroff & Scanlon, 2002; Jonassen & Rohrer-Murphy, 1999; Kuutti, 1996; Nardi, 1996; Sharples et al., 2007). This theory is also often found as a framework in medical education research settings (Brown, 2010; Varpio et al., 2008; Wearn et al., 2008). In Leontiev's (1974) theoretical framework of activity theory, there is an "activity" in which subjects (e.g., medical students) perform activities with the help of tools (e.g., a stethoscope) to achieve certain goals (e.g., good patient care). Here, the individual does not act in isolation, but belongs to one or more communities (e.g., clinical teams) organised by a fixed division of labour (e.g., what a student does). Actions are subject to explicit and tacit rules (e.g., in which situations do we use a stethoscope) (Engeström, 1987, 2001; Varpio et al., 2008). Considering the theoretical foundations presented and the gaps present in the literature, the following research questions were formulated:

- Research question 1: To what extent does the adoption of tools (in the form of new ICT) lead to new and adapted learning activities of undergraduate students and residents in resource-constrained environments?

- Research question 2: To what extent does the adoption of tools (in the form of new ICT) lead to contradictions and changes of rules, communities and division of labour in the respective activity systems?

Method. To address these research questions, a qualitative methodological approach in the form of focus group interviews was used. According to Barbour (2005), these are suitable for capturing transformations in the context of medical education. The medical education in Nepal was chosen as a case study, as this country with a strong Hindu and Buddhist background is one of the poorest countries in the world (UNDP, 2011). The 43 members of the focus groups were selected using purposive sampling (Patton, 2002) and consisted of undergraduate students, graduate students, faculty members, and teaching staff from one public and one private university. This ensured that diverse perspectives were included based on their respective roles, ages, and socioeconomic and organisational backgrounds. A total of eight focus groups were conducted, consisting of four to eight participants, and ranging in duration from 57 to 93 minutes. Two researchers conducted the interviews and regularly swapped the roles of interviewer and observer and took notes during the session and fieldwork. The qualitative data analysis software NVivo8 (Silver & Lewins, 2009) was used to analyse the recorded and verbatim transcribed interviews as well as the taken field notes. Based on Mayring's (2004) deductive principles of qualitative content analysis, an analysis was conducted on the data gathered. On the basis of the adoption and appropriation of new ICT instruments in the form of new and emerging "activities", the other elements involved and the resulting tensions, contradictions, and changes in the activity system were adopted as an analytical framework. Both researchers, who also conducted the interviews, jointly coded 75% of the data. The remaining 25% was coded by the first author. Results were discussed with all authors and debated as necessary until agreement was reached. In addition, as part of member checking (Giacomini & Cook, 2000), all focus group participants were asked to comment on the results gained. Feedback from member checking and discussions with the authors were integrated into the study.

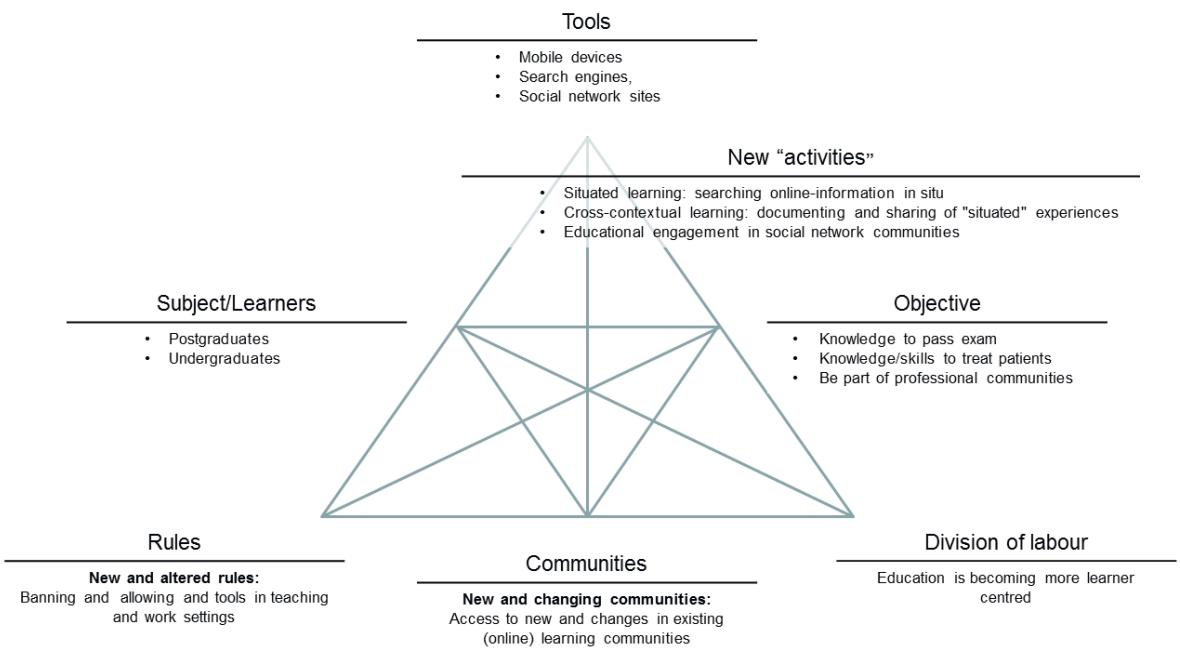
Results. With regard to research question 1, the following three new and emerging learning activities were identified. These were related to the introduction of mobile devices (primarily mobile phones, less frequently, laptops) within a three- to five-year period. (1) Searching for ad hoc information: Mobile devices were found to enhance learning and cognition by linking codified knowledge with situated cognition in situations requiring spontaneous retrieval of information. All students in the focus group

reported using mobile phones frequently to search for information. This usage behaviour often occurred when participants were confronted with unfamiliar technical terms or concepts in their daily academic and clinical lives. (2) Documentation and sharing of images and videos: Students often used their mobile devices in the clinic to document specific cases, medical instruments, or procedures. This allowed them to capture and later share and repeat situational experiences, sometimes in other learning contexts (e.g., peer group, traditional lectures, or presentations to faculty). (3) Educational engagement in social network sites: Various members of the focus group (students, residents and faculty) indicated that they used Facebook for medical education and training and considered it relevant to their learning.

Focusing on research question 1, the analysis of qualitative data showed that the introduction of new ICT tools led to tensions, contradictions and conflicts with already-existing components, such as rules and regulations. For example, tensions could manifest themselves through activities that students tried to hide from lecturers. For instance, one university prohibited access to social networks or non-educational websites during class hours. However, these emerging tensions also meant that rules sometimes changed over time. The above ban, for example, was lifted after a while if the devices and the websites visited with them were used productively and in a medical education context. The analysis also showed that the implementation of ICT led existing communities to adapt their already-established practices, for example, when students communicated with their fellow students on social networking sites and expanded their existing offline communities. It was shown that the use of ICT, and specifically Facebook, allowed students to connect with socio-cultural communities (e.g., international medical groups) that were previously difficult or impossible to access. This extended beyond existing local boundaries that were not already connected to existing offline communities. Of particular note was the finding that the existing division of labour was altered by contradictions in the activity system. Although teacher-focused instruction remained the main source of information within formal education, students designed and implemented new and emerging activities (e.g.: Locating new medical information and then sharing it with lecturers). Figure 4 maps the results identified for research questions 1 and 2 in the graphical representation of an activity system showing the adoption of ICT as tools for learning in medical education in developing countries.

Figure 4

Activity System Regarding the Adoption of ICT as Tools for Learning in Medical Education in Developing Countries



Discussion and Conclusions. The results showed how extensively and quickly learners adopted mobile devices in the existing activity system as new cultural tools and appropriated these devices for teaching and learning in informal learning settings. Our analysis was able to identify three tool-based activities (see Figure 4) that allowed for a previously impossible optimisation of situated and cross-contextual learning and opened up new pathways to professional participation. Thus, mobile devices and SNS enabled completely new ways (1) of optimising situated learning by using virtual information sources directly in a learning situation. In addition, multimedia documentation of learning situations occurring in practice allowed for (2) cross-context learning, in which materials were used for later engagement and discussion. A further activity was related to (3) engagement with educational content in social networks. Here, new activities developed that were centred around the learners. In addition, our study was able to show that the modifications are not limited to a single activity system, but that the ASs of all involved groups of participants (students, residents, faculty, and lecturers) influenced each other. These observations have also been made in other studies in a medical setting. For example, Balmer et al. (2008) described how undergraduates and postgraduates stimulated learning among their medical faculty, or Bleakley (2002) referred to transformations in clinical organisational

cultures. This means that the adoption of new tools equips learners with an increased ability to act, which, according to Pachler et al. (2010a), allows them to manage and influence socio-cultural structures and established cultural practices. This is particularly relevant with regard to the teaching and learning culture predominant in Nepal, as lecturers are held in high esteem and possess a high hierarchical position in the social structure. This manifests itself, among other things, in the fact that students have been taught not to ask questions (Lemone, 2005). This form of "emancipation" and the findings above show that formal learning settings and the teachers involved in them are no longer the exclusive "gatekeepers of knowledge and personal expertise" (Pachler et al., 2010b).

Our study highlights and discusses key developments and systemic implications emanating from them in the context of medical education in developing countries. However, within the scope of the present study, the identified new and emerging tool-based activities could not be addressed in depth. Some methodological issues need to be considered when interpreting the results. The focus group sample was composed only of interested individuals, which may have led to bias in the data. Furthermore, the focus on a single survey period and a single cultural setting has a limiting effect. However, the impact of ICT on health system transformation has been described in other cultures and countries (e.g., Syed-Abdul et al., 2011). The focus on cultural-historical action theory proved to be a suitable analytical framework, although it cannot explain all of the present observations in depth. To achieve this, future research projects should include broadening the geographic and cultural scope, use quantitative methods to increase the generalisability of the results, and conduct long-term observations to identify developments over longer periods of time. Also, the results obtained can be theoretically aligned with work from other research fields to expand the underlying knowledge base [e.g., theories from the field of mobile learning (Pachler et al., 2010a), non-formal learning (Eraut, 2000) or social networking sites (Merchant, 2012)].

Summary of Manuscript 4: Facebook as a Learning Tool? A Case Study on the Appropriation of Social Network Sites From Mobile Phones in Developing Countries

Aim of the Study and Motivation. Projects in the fields of information technology for development [ICT(4)D] or mobile technology for health (mHealth) often use technocentric as well as deterministic approaches in which learning materials and knowledge, in the form of technologies or software, are implemented centrally or transferred to later users via "push-strategies". According to Traxler (2012), it is a common practice of the mHealth community “to pump information through the infrastructure” and to do so with "educationally naïve" ideas. In both approaches, knowledge and technology seem to be primarily transferred unilaterally from "developed" to "developing" countries, respectively from experts to novices. In contrast to this approach, which is often based on a binary and quantitative model of adoption, the concept of appropriation focuses on how individuals use a technology after it has been accepted, or adopted (Wirth et al., 2008). Here, according to Pachler et al. (2010a, 2010b), appropriation refers to the occurring "processes of the internalisation of the pre-given world of cultural products," and this internalisation is achieved through use in the context of social practices that occur either in or outside formal educational settings. With regard to the described situation, this exploratory research study focused on the goal of investigating aspects of the appropriation of technologies, e.g., social networks and mobile phones, in the environment of developing and emerging countries in Asia.

Method. To achieve the above-mentioned objective, Nepal, ranked as one of the poorest countries in the world (UNDP, 2011), was selected as the study destination. The primary focus in this study was on the relevance and function of mobile devices and the social networking platform Facebook for student learning. Two different data sources were accessed for the analysis. First, informal interviews and focus groups were conducted directly in Nepal. Two researchers conducted eight focus groups (three to eight participants each) in which they interviewed a total of 43 people. The group of individuals consisted of medical students (n=21), postgraduate medical students (n=9), and medical lecturers and faculty members (n=13). The undergraduate and postgraduate group consisted of 11 women and 19 men with a mean age of 25.3 years (from 21 to 33 years). In order to obtain a representative picture of the Nepali university population, the members of the focus groups were drawn from medical institutes in both a private and a public university. The private university was the Nepal Medical College & Teaching Hospitals, and the public university, categorised as being affordable (Bajracharya et al., 2006),

was The Institute of Medicine of the Tribhuvan University. The interview guide primarily addressed the topic area of use of ICT by undergraduate and graduate students for medical learning, work, and leisure.

Second, the information obtained in the focus groups was compared with the content of the Facebook site "Medical Profession, wow I Love it" (http://www.facebook.com/Medicalprofession). This site addressed medical and clinical topics and various members of the focus group as well as other members of the two participating medical faculties highlighted their participations there and the importance for the clinical and student everyday life. It was not possible to directly attribute the activities there to the focus group members, but analysis of the group content allowed a comprehensive examination of the learning and teaching practices of a high number of medical students and physicians, primarily from developing and emerging countries.

The qualitative data analysis software NVivo8 (Silver & Lewins, 2009) was then used to analyse the recorded and transcribed interviews as well as the field notes. In addition, all data and activities (from October to December 2012) from the aforementioned Facebook site were also secured and analysed. Based on Pope et al. (2000) and the inductive principles of qualitative data analysis postulated there, coding was done by one researcher and subsequently the other authors read and interpreted about 30% of the data. When interpretations differed, the results were critically discussed until agreement was reached. In addition, focus group participants were involved in quality assurance, receiving a summary of the results and confirming them even without changes requests.

Results. The interviews revealed that the vast majority of students had mobile phones with Internet access and used them for daily use of Facebook. The analysis of the data showed that the use of Facebook had a strong impact on the information and communication practices of the participants. For example, Facebook was reported as the most frequently and intensively used platform and was often the reason why students activated the Internet on their devices in the first place. Facebook use was described by focus group participants as a trigger for mobile Internet use (laptops were rarely used) and for a radical and rapid change in media use. During the focus groups, it became apparent that students also used Facebook for medical education, often referring to a specific Facebook site where they participated in medical and clinical discussions and learning activities. This Facebook site mentioned and also examined in this study was "Medical Profession, wow I Love it". It had several thousand interactions per week and can be considered relatively popular, with more than 36,000 endorsements. Many of the interactions there were initiated and maintained by medical students and

clinical experts from developing and emerging countries such as Nepal and India. The content analysis of the Facebook site showed that a small proportion of non-medical and non-educational content was shared there, but also an extensive number of interesting medical topics that can be directly related to knowledge acquisition and learning practices. Thus, the explicit presentation of educational content (e.g., links to full versions of textbooks, medical videos) and also the specific use of learning methods (e.g., mini-cases, quizzes) were evident. For example, many of the group members used the "wall" of the Facebook site and participated in quizzes via the posting and commenting functions (see Figure 5). The analysis of the content of the Facebook site showed a high number of open and closed quiz questions that covered a broad medical spectrum. These activities were positively received by the community there and were frequently commented on, recommended, and answered. Some focus group participants indicated that often the more complex or interesting questions were those that were shared most frequently within their own peer groups. Engagement with the educational materials in the form of questions, cases, and images was seen by students as a valuable learning opportunity in their formal education and the textbooks used and provided at their institutions. In addition to the provision of learning content, the analysis also identified a large number of contributions relating to socio-cultural aspects in the context of participation and the expression of a professional medical identity. This could manifest itself, for example, in the form of jokes or surveys related to the medical profession.

Figure 5

Example of Two Forms of Quiz Questions on a Facebook Wall

Discussion and Conclusions. Whereas Madge et al. (2009) postulated that students' activities on Facebook were social in nature but not used for "relatively" formal learning and teaching, the results we obtained allow us to draw different conclusions. The Facebook site studied showed diverse types of clearly identifiable pedagogical and academic content as well as the use of diverse learning and teaching practices often associated with the classic functions and activities of computer- or web-based training

as well as learning management systems. These occurred in the form of medical case discussions, quizzes, and the provision of external (multimedia) knowledge and learning resources. The Facebook site provided a distinct informal learning context and the type, and the form of content, methods and knowledge resources presented there can be attributed to more classical approaches to (higher) education in formal training and learning settings. Our results demonstrated that medical students and professionals have appropriated the functions of a social networking site as a partially formal (e-)learning environment. They have done so in an informal learning context, applying approaches and behaviours in using such platforms for which they were not originally developed.

The content and activities presented on the evaluated Facebook site also illustrate the blurred boundaries between diverse cultural practices (entertainment and learning) mentioned by Pachler et al. (2010b). Regarding the learning content provided on the Facebook site, statements from participants revealed that externally developed expertise (e.g., Facebook) was not included and considered in formal on-site training, since this knowledge was not provided by traditional educational institutions. The focus group lecturers indicated that medical content and experiences that came from Facebook activities were not addressed and included in formal education. One of the universities even prohibited students from accessing social media tools during class time. Due to this restrictive approach on the part of the educational institutions, the blurring of boundaries is currently still being done unilaterally by the student body. The analysis also showed that lecturers and educational institutions are no longer the exclusive "gatekeepers" of (formal) knowledge" (Pachler et al., 2010b). This observation becomes especially important in resource-constrained settings. In these, access to (formal) knowledge is often limited to teachers and an often-limited number of textbooks. The observation made in the conducted study that the majority of people involved on the Facebook site were from developing and emerging countries supports Pachler et al.'s (2010b) assertion that social mobile learning practices can be characterised by distributed resources, power, and practices in different environments and across different lifestyles.

The results and findings obtained should be further analysed and addressed in more depth in future work. For example, it could not be clarified how many of the people involved on the Facebook site actually engage in educational activities. Also, the site we studied is only one of many Facebook sites that deal with clinical and medical professional groups. Here, future work should address these gaps and consider a larger number, culturally-specific groupings, and a broader field to provide a more comprehensive picture of the influence of medically-related SNSs.

Summary of Manuscript 5: Facebook for Supervision? Research Education Shaped by the Structural Properties of a Social Media Space

Aim of the Study and Motivation. The status of research as a driver of a country's innovative capacity and economic development, and also of its research education has increased in government and society (Pearson & Brew, 2002). An element of research education is research supervision and according to Evans (2009), this method can help students in their development as independent and critical researchers. However, it should be noted that research supervision includes didactic components that take place in a complex communicative environment (Pearson & Brew, 2002) and should be considered as a highly complex and advanced teaching format (Connell, 1985). According to Manca and Ranieri (2013) social media, especially social networks sites, are increasingly being appropriated by students in their educational lives and educators are increasingly using these tools to enhance their teaching activities. Based on the developments and factors listed above, the aim of this study was to investigate how the use of a social media space, in this case a Facebook group, contributes to the development of analytical and research skills in a learning group. In doing so, we aimed to create an understanding of how learning and supervision actually take place in the social networking space and are shaped by the characteristics of this space. To achieve the formulated goals, an existing intervention was used in which a social network was employed to facilitate research supervision for a team of students in a marginalised setting. Furthermore, the following two research questions were formulated:

- Research question 1: How did research supervision and learning unfold in the written interactions between students and supervisors?
- Research question 2: How did the embedded and wider structural properties of the space shape this interactional achievement?

Method. For this study, a teaching module was used that was designed to develop the analytical and research skills of students. The participants of this course were 47 nurses enrolled in a part-time, advanced midwifery education programme in rural areas of KwaZulu-Natal province, South Africa. These students had very little prior research experience and very little exposure to social media.

As part of this module, students were divided into five teams and had to collaborate on a concept for a research proposal from their field within five months (end of January to June 2013). During this process, they were supervised by one or two experienced researchers. This supervision was conducted

in an entirely online setting and a closed group on the social network Facebook served as a platform for the exchange. To enable cross-group communication and teaching, all groups were assigned to the same room on Facebook.

In order to analyse how the supervision by the experienced researchers and learning took place in the closed room, semi-grounded discourse analysis was conducted. The theoretical conceptions of Lee (2008), who identified five core elements of supervision [(1) functional supervision, (2) enculturation and (3) emancipation, (4) critical thinking and (5) relationship development], served as a priori concepts (Mayring, 2004). The analysis focused on conversational patterns and learning was not measured as a mental phenomenon but as "interactional achievement" (see Koschmann & LeBaron, 2002). In other words, comprehension and meaning were achieved through students' and teachers' written and digital communication. Next to the written interactions the analysis focused on potentialities and constraints of the embedded and wider structures of the social networking group. With this approach it was possible to take multimodal social semiotics perspectives into account and to obtain a deeper understanding of how learning and supervision were constructed. Furthermore, a semi-grounded approach for analysis based on the concepts of Domingo et al. (2014) was also used. This included how written interactions were related to political and cultural ideas, and how authority is shaped by factors such as design, navigation, linearity, modularity, and reading paths. Qualitative data analysis software *NVivo8* (Silver & Lewins, 2009) was used to analyse the content of the Facebook group including written conversations, images and links.

Results. It was shown that one of the key elements of learning was the interaction between the student teams and the supervisors in the closed Facebook group. Specifically, students were asked to articulate and rearticulate elements of the research proposal by these experienced researchers. Based on the five key elements of supervision [(1) functional supervision, (2) enculturation and (3) emancipation, (4) critical thinking and (5) relationship development] defined by Lee (2008), the main supervision methods used are described and conceptualised below.

Supervisors supported students through (1) functional supervision by guiding them in the meaningful sequence of completing their tasks through thematic feedback and meta-supervision. The majority of the observed interactions involved functional supervision. For example, students received specific thematic feedback, change requests for specific elements of the groups' research proposal, as well as - in the context of meta-supervision - instructions and general orientation. However, effective

communication and mentoring was found to be hindered by Facebook's sequencing mechanisms. These always placed new posts at the top of the group site and thus consistent and chronologically correctly ordered reading paths were disrupted. This resulted in communicative decontextualisation and led to increased effort, high content redundancy, and high asynchronicity costs (Clark & Brennan, 1991) for all participants, as they had to re-establish the contexts of the content.

The activities through which students become members of an academic discipline is described as (2) enculturation, while (3) emancipation, according to Lee (2008), is linked to the gradually decreasing need for guidance by supervisors. Participants of the analysed intervention achieved only a limited degree of independence. While many of the interactions analysed included aspects of functional mentoring and critical thinking, there was limited indication of enculturation. In the interaction with the groups, the supervisors linked enculturation with the use of an exclusive language, which is to be understood as a constitutive element of the research community and its differentiation from other cultural groups. It turned out that two forms of language were used in the group room. First, a more informal and colloquial form for interpersonal communication, and second, a formal style of language that was primarily used when students were explaining various elements of their research proposal. An inherent tension was created by the use of a personal space on a social network platform, usually associated with informal language, and by the requirements to use more formal language to describe the purposes and elements of the research.

Fostering (4) critical thinking is a central goal of research supervision and was a dominant category in the collected data. During the intervention, supervisors encouraged students to question, justify, and criticise their own and others' ideas and to ask and answer questions. The analysis showed that these requests resulted in minimal peer interaction, despite the fact that Facebook was designed as a peer-to-peer medium. The reluctance was particularly noticeable when research concepts of other groups were to be critically commented on. Additionally, the technological structuring of Facebook posts made it difficult to develop critical arguments in a recursive and multi-step manner, as there was only one structural level of questions and answers. This technical characteristic did not support the development and visualisation of deeper and interrelated levels of discussion in an original posting. This led to participants using self-selected text anchors to connect different postings that were thematically linked.

An additional key element of supervision is (5) relationship development and emotional proximity. Due to the lack of co-presence, the development of personal relationships in e-supervision is considered to be a challenge (Pachler & Redondo, 2012). At the beginning of the intervention, a pronounced social distance dominated among all participants. Discussions were objective and intellectual, while socio-emotional components rarely occurred. In the beginning, the supervisors emphasised the educational and research-oriented character of the group room to counterbalance the general perception of Facebook as a social and private exchange platform. However, shortly after the five-month period started, an increasingly social community developed between the students and supervisors. In addition to relationship building, a socio-emotional presence was established in the Facebook group, caused by a variety of motivational and affective messages, but also by the dissolution of boundaries between educational and private contexts. Thus, communication took place during working hours and leisure time, and the signs of the private use of the social network (e.g., profile pictures with friends and families) were also visible in the professional educational setting. These elements were directly related to their posts, which contained mainly intellectual and research-oriented discussions. In this way, facets of participants' private lives merged directly with professional and educational discourse. Through this mechanism, broader political and cultural ideas were also introduced into the social media space (e.g., through political or culture-related profile pictures).

Discussion and Conclusions. The concepts described by Lee (2008) could be observed in the observed interactions between students and supervisors. Thus, indicators of functional supervision and critical thinking were primarily identified in the analysis, which can be attributed to the demands of mentoring students in the early stages of an academic career. However, the technical aspects of the group room affected this process by structurally disrupting the presentation of support material and assignments through the sequencing algorithm (new contributions first). This made it difficult to monitor and follow the activities and contributions of all participants. This algorithm is a characteristic of social networks, but it increased coordination and acquisition effort and made possible grounding difficult (Clark & Brennan, 1991). This hindered well-structured learning paths and replaced them with volatile, point-to-point episodes of learning. A sustained and stringent record of interaction, as suggested by Sussex (2008), was not achieved. Facebook groups are accordingly less suitable for in-depth and structured peer learning. In the intervention, the enculturation of students into a research community was explicitly linked to the acquisition of a specific, formal language and its usage was also specifically

requested by the supervisors. In addition to the factor that English was the students' second language, the use of a social media space also affected the use of formal language. Eisenstein (2013) noted that the language used in social media environments very often contradicts even basic expectations of vocabulary, spelling, and syntax. The primary use of mobile phones as input devices by the students in the present study may have furthered this effect, as these devices have particular simplified input methods and nonstandard forms of expression (Gouws et al., 2011; Thurlow & Brown, 2003). Thus, enculturation as a process of linguistic development is influenced by dominant sociolinguistic structures enabled by the social and mobile media spaces used.

In the analysed interactions, the supervisors encouraged critical thinking and the development of critical thinking skills; however, both elements were rarely observed in the recorded interactions. This may be due to lack of research experience or resistance to critical feedback among peers. However, the technological structures of the Facebook group may also impact critical thinking. For example, Friesen and Lowe (2012) highlighted that Facebook promotes a culture of socialising and "liking" and that disagreement and controversial debate are only encouraged to a limited extent. Further studies also showed that Facebook inhibits critical thinking skills (e.g., Hampton et al., 2014; Robson, 2015).

Robson (2015) also observed that critical disputes were more likely to occur when users were anonymous and were obstructed when users were clearly identified. However, the same effect provides intimacy and is an important component for developing and maintaining relationships in supervision processes. Another factor in intimacy and relationship development was the constant interaction across time, work, and educational boundaries, even in the private sphere. This promotes the emergence of an intimate domain in which interpersonal relationships can be permanently maintained without temporal or physical boundaries and has been described by Habuchis (2005) as the concept of "telecocooning."

In conclusion, learning and supervision were not pure products of interaction, but were influenced by the social media space. Learning and supervision were enabled and constrained by the interplay of inherent technological, functional, and multimodal as well as broader socio-cultural, political, and sociolinguistic structures of the spaces.

The results of the study are based on a specific context (inexperienced digital users in rural South Africa) and should be interpreted with appropriate caution. Future work should pick up here and complement the observed dynamics in other contexts.

Summary of Manuscript 6: Informal Mobile Learning in Nurse Education and Practice in Remote Areas—A Case Study From Rural South Africa

Aim of the Study and Motivation. The use of mobile devices is gaining popularity in nursing, whether practice or education (Garrett & Klein, 2008). For example, Wu et al. (2011) examined the use of smartphones in daily clinical practice by nursing students in Taiwan, while Clay (2011) analysed the use of podcast on mobile devices as a learning support for midwives in a UK study. Further studies from the U.S. and Canada showed that hospital staff (professional and students) considered mobile devices helpful for on-the-job learning (Garrett & Klein, 2008; George et al., 2010; Kenny et al., 2009). Yet there is little understanding of how nurses and midwives from low- and middle-income countries can use mobile devices for informal learning in low-resource and remote settings. In this regard, nurses and midwives in these countries often have a key role in health care delivery (Green, 2006), but they often work in isolated settings and have little access to continuing education and support (Raisler & Cohn, 2005). In the light of this situation, the use of mobile devices is seen by UNICEF, ITU, and the World Bank as a way to support health workers in such resource-poor regions and situations (Holmes, 2010; International Telecommunication Union, 2010; The World Bank, 2012). Therefore, the goal of this research study was to shed light on the usage of mobile phones as educational tools for nurses in disadvantaged and remote areas.

Method. To address the identified gaps and expectations highlighted above, we formulated the following research question:

- Do nurses in disadvantaged and remote areas use mobile phones as effective educational tools, and if so, how?

The study was conducted in a province of South Africa that has high infant and adult mortality rates and most of whose residents live below the poverty line (Coovadia et al., 2009). The main focus was on nurses based in this region who were enrolled in an advanced midwifery education programme in this province. These nurses working in this region are provided with little and difficult continuing education and up-to-date evidence-based information and must work in isolation due to geographical distances. Typical case sampling according to Patton (1990) was used to obtain interviewees typical of midwifery, nursing, and education practice. The final sample consisted of 16 nurses who were selected for interviews. These could be divided into three different roles, thus allowing to capture the broadest

possible picture of learning practices related to informal learning in the workplace and formal education. The sample consisted of (1) eight nurses from the region who were registered nurses, working in a clinical setting, and enrolled in a midwifery course at a South African university. In addition, (2) four nurse facilitators were selected which assisted the nurses in bridging the gap between the formal education programme and their clinical work. Also, (3) four nurse managers were interviewed as they have expertise regarding the work realities, learning practices, and needs of nurses in their clinics. In order to collect the necessary data, semi-structured interviews were conducted with the 16 nurses at three rural health centres between June and August 2012. For this purpose, an initial question guide was used that focused primarily on learning practices at work and at university, with an emphasis on the connected use and perceived impact of mobile devices. Qualitative data analysis software *NVivo8* (Silver & Lewins, 2009) was used to analyse the recorded and transcribed interviews. In line with the research question, the selection criteria and level of abstraction for the categories were broadly defined as socio-cognitive and socio-cultural forms of learning. These forms are appropriate to capture the broad field of education supported by mobile technology (see e.g., Pachler et al., 2010a; Pimmer et al., 2010) and appropriate for analysing forms of teaching and learning in the domain of health care. Learning in the health care area often encompasses on-the-job learning in the form of authentic and problem-based learning (see e.g., Norman & Schmidt, 1992; Slotnick, 1999) and learning in the context of participation in communities of practice (see Jordan, 1989 for medical context; and Lave & Wenger, 1991 for the general theory). Based on this, for the analysis, learning was understood as an activity that included work-related learning activities (primarily problem solving and critical thinking) and any evidence of nurses' participation in a community of practitioners and learners. Based on Pope et al. (2000), all relevant steps of the study (design, analysis, and interpretation) were conducted jointly by the authors, who represented different academic professions, in order to reduce the influence of individual disciplines and researchers. Coding of all interviews was conducted by one of the researchers. Subsequently, 25% of these data were independently interpreted by two authors, and when interpretations differed, the results were critically discussed until consensus was reached. Based on the recommendations of Mays and Pope (2000), the interviews were repeated with three participants to achieve validation by the participants. To do this, the current status of the results was presented, and these were validated by the three individuals.

Results. Our analysis of the data led to the identification of five learning practices that were facilitated by the use of mobile devices.

(1) Authentic problem solving: The nurses were often confronted with patient cases in their daily clinical practice that they lacked sufficient skills to solve. In these situations, participants used mobile devices to engage their virtual communities in synchronous on-site problem solving. These communities were often in different geographic and virtual spaces and consisted not only of fellow course students and facilitators, but also included external colleagues from other medical specialties. In these cases, mobile phones enabled learning in patient-centred problem-solving processes and generated both mobile and blended learning scenarios.

(2) Reflective practice: We were able to reveal that mobile phones allowed for interaction among nurses and with third parties, facilitating group discussions and reflective behaviour. Diverse nurses and facilitators described the ways in which mobile devices were used to document, share, reflect, and discuss professional situations. For example, interesting and challenging cases and professional experiences were often captured in the form of photographs taken with mobile devices. These documentations were then used at a later time as a basis for discussion and reflection within the classrooms, the clinic area, or in virtual spaces. The multimodal use of text and images common within mobile phone use allowed various local, virtual only, or hybrid communities of interest (e.g., colleagues in the clinic, virtual alumni networks, and fellow students on the course) to be included in situated learning. In addition, this was independent of geographic, professional, or temporal boundaries. Sharing information with diverse groups of individuals from professional and educational contexts underscores the importance of mobile phones for iteratively connecting and mediating learning in the workplace and in a formal educational setting.

(3) Emotional support and belongingness: In addition to observed strictly professional and educational use of mobile phones, emotional and social communication practices could also be identified. Frequently, virtual social communities, fellow students, or facilitators were asked for support by students in emotionally stressful situations, via mobile phones. These situations could be directly related to the daily clinical or educational routine (e.g., anxiety about new situations), but also to scenarios that were not related to solving clinical tasks, such as personal or family problems. These behaviours dissolved boundaries separating the formal educational setting, professional work, personal life, and different peer milieus with the help of mobile technology.

(4) Realisation of unpredictable teaching situations: The dynamic nature of the workplace and, to some extent, the formal training programme make it difficult to plan fully for these two aspects. For example, both points can be influenced by patient workloads and patient cases. In these cases, mobile phones served to make the situation more flexible and enabled new learning situations to be created or organised. For example, organisational changes could be announced at short notice (e.g., postponing a lesson) or facilitators could be called in to discuss interesting and course-relevant patient cases. Mobile devices thus enabled unpredictable on-site teaching and allowed the linking of everyday work with formal education.

(5) Life-long learning: In the interviews, it emerged that the mobile phone was considered to be the most relevant computer tool. Thus, while its value for personal use was emphasised, it was also highlighted that mobile phones are used and valued in the broader nursing community. In our sample, younger students were found to use the devices more frequently and more extensively in professional and personal settings than older colleagues. The latter often indicated that they had been introduced to mobile technologies by their children. The documented frequent, intensive, and widespread adoption occurred despite the fact that clinical and course management were often hostile to or prohibited the use of mobile devices in professional contexts. Therefore, mobile devices are essential for lifelong learning for nurses in remote and resource-poor areas by providing previously almost impossible access to learning resources (e.g., web searches for medical diseases) or social communities (e.g., on social networking sites).

Discussion and Conclusions. Our study showed that nursing students in low-resource environments used mobile phones in teaching- and learning environments. A variety of cases of use for mobile learning could be identified. In addition to accessing clinic-related information at the workplace via the Internet, mobile devices were also frequently used for social communication. This became apparent through the mediation and peer-to-peer generation of local knowledge (e.g., joint problem solving and reflection) and emotional support. These findings support the claim that mobile devices can promote socio-cognitive learning processes (George et al., 2010; Pimmer & Pachler, 2014). Furthermore, as in similar related studies (e.g., Pimmer et al., 2012, 2013), it was observed that the nurses frequently used their mobile devices for exchanges in social and professional online groups. The observed socio-cultural participation would not have been possible to this extent without mobile devices. In addition, it could be demonstrated that learning environments are no longer clearly separated due to

the use of mobile phones. For instance, previously restricted and locally established communities of practice intermingled with previously restricted education-related online groups. Study participants from resource-limited areas used social apps to learn in mixed and mobile groupings. Geographic, social, temporal, and thematic differences, as well as local and virtual boundaries, were overcome. The participating nurses used a variety of tools that also allowed synchronous and asynchronous communication with diverse peer groups and adapted their use depending on the work or learning situation. Our study demonstrated the use of mobile devices to connect formal learning (in the context of the provided education programme) and informal learning settings (the workplace). The nurses' mobile phones supported boundary crossing (see Akkermana & Van Eijckb, 2013) and connected persons working in isolation by allowing engagement of diverse knowledge sources and fragmented communities. In lower income countries, mobile phones are often the only tool to access additional knowledge resources and to reduce professional isolation, a major problem in developing countries, according to WHO (2010). The use of this technology, besides all its benefits, presents ethical and practical challenges that need to be addressed by educational institutions. These include patient privacy, the development of professional attitudes and safe practices in the use of mobile devices and related apps. Rather than prohibiting the use of mobile devices in the workplace, as has been observed, the nurse education curriculum should address these challenges and equip students with a broad set of health and media literacy skills, including the use of virtual content, including access, analysis, evaluation, content creation, and sharing (Livingstone, 2004).

Given the qualitative method used in this study and the specialised sample, the results of our study cannot be generalised. Due to methodological limitations, future research should include the quantitative measurement of the impact of mobile learning on professional isolation, problem-solving skills, and patient care. A further focus of investigation could be on the use of instructional design methods commonly used in medicine [e.g., problem-based learning (Barrows & Tamblyn, 1980) or scaffolding (Greening, 1998; van de Pol et al., 2010)]. Also, learning practices observed in resource-limited regions could be investigated in Western hemisphere systems, such as the UK National Health Service, where collaborative learning is, according to Spilg et al. (2012), characterised by increased individualisation, hierarchies, geographic and administrative boundaries.

General Discussion

The topic that connects the individual studies of this PhD framework paper is the role of culture, which is explored in its manifold meanings. This discussion highlights the insights and implications that the various manuscripts provide regarding culture in HCI.

The first strand of this thesis was based on two articles which show, firstly, that (national) culture as a research field remains a slow-growing and still poorly-considered area of research in the most relevant HCI publishing outlets. Secondly, they demonstrate that participant samples at the most influential HCI conference, CHI, can primarily be assigned to the Western cultural sphere and originate from countries with a tendency toward higher rates of education, wealth, industrialisation and democratisation. In essence, culture is neither considered sufficiently as an explicit factor (e.g., as a construct or variable), nor does the field embrace cultural variety regarding the study (and studied) subjects.

The second manuscript demonstrates that participant samples at CHI do not represent the world population at all. 73% of the findings at CHI (between 2016 and 2020) were based on studies that relayed on participant samples from Western countries. What follows from this is that about three quarters of all results on the CHI are based on less than 12% of the world population. In addition to the clear geographic focus, we were also able to show that the CHI participant samples also came from countries that can be considered as educated, industrialised, rich and democratic. In fact, as many as 97% of all articles with Western participant samples met all the conditions required to be considered entirely WEIRD. These rather modest results, in particular with regard to the claim of the SIGCHI Executive Committee "to foster HCI growth around the world" (Mentis et al., 2018), gain further weight if one considers that more than half of the existing countries (102 out of 195) were not included in the studies analysed, or represented by participant samples. Given the ways in which cultural practices can shape the use of technology – which is a key conclusion of the papers in the second strand – these observations probably restrict the broader “external” validity of much of the extant literature. Consequently, there is very little knowledge about the use and usability of technologies in most of the countries of the world among the CHI community. The cultural “neglect” and one-dimensionality become evident in manuscript 1: The vast majority of the papers in the overall sample studied did not include

culture (about 98% to 99%, depending on the study period), and those that did recruited participants predominantly from the US context.

However, we also found positive developments. Notably, the findings demonstrate an almost doubling of participant samples (from 16.31% to 30.24%) from non-Western countries. At the same time, the number of Western participant samples declined continuously during the study period (from 83.69% to 69.76%) and the largest representative of this group, the USA (with 45.82% of all participant samples of the CHI), recorded a strong decline in participant samples (from 43.56% in 2018 to 24.84% in 2020). This is particularly noteworthy since study participants in the social sciences are mostly European Americans (Arnett, 2008). The following three factors could have an influence on these developments: On the one hand, (1) the strategic orientation of SIGCHI (Mentis et al., 2018) to make the CHI community and authorship more diverse could have contributed to this development, as we were able to show that authors mostly recruit in their respective countries of work, and at the same time, (2) technological advancements in the development of study designs (e.g. data collection) could also have had an influence. It was shown that the use of online studies and behavioural logs increased, and the participant samples included there were often from a range of countries. Furthermore (3) studies in the fields of ICTD and HCI4D caused an increase in studies with participant samples from non-Western countries (e.g., Barbareschi et al., 2020; Chen et al., 2022; Varanasi et al., 2022) and from WEIRD countries with persons who had low education and/or a low income (e.g., Chaudhry et al., 2019; Dillahunt et al., 2022; Lin et al., 2022; Vines et al., 2014) or different ethnicities (e.g., Harrington & Dillahunt, 2021; Lozano-Rolon, 2020; Taylor et al., 2015). These studies contributed to making the participant samples of the CHI more diverse. HCI studies in recent years which deliberately examined diverse countries and cultures showed that technology uses can differ greatly. Ranging from visual preferences on the web (Reinecke & Gajos, 2014) or the perception and interpretation of emojis (Kimura-Thollander & Kumar, 2019) to privacy behaviour (Sawaya et al., 2017). These are reasons for CHI and the CHI community in general to take this diversity into account in their studies and thus enable technologies that are comprehensively useful and usable globally.

The second strand centres on the examination of the relationship between HCI, particularly in knowledge-intensive practices (e.g., learning, collaborating, knowledge sharing, etc.) and cultural and socio-cultural systems drawing on studies from the Asian and African context.

One central observation of several studies in the second strand is that the introduction of a technology into an existing system (cultural historical activity system) can lead to tensions (in the sense of contradictions) and then to significant changes within that system over time, which follows the logic of Engeström (2001). In manuscript 3 we show how learners (medical students from Nepal) appropriate mobile and social media technologies in specific ways. The emerging activities provided the medical students with the opportunity to enhance their situated learning (O'Brien & Battista, 2020) in several ways. The learners were enabled to directly access virtual information sources in acute multimodal, situated experiences and to optimise their learning in and with these situations by documenting (via videos and images) this experience. Furthermore the emerging activities allowed later reflection on action (Schön, 2017) and discussion with the help of the generated documentation as well as the possibility to engage with subject-specific learning content in specialised groups on social networking sites. Importantly, with regard to cultural systems, the study showed that these processes of appropriation caused tensions regarding previously established rules and practices within the system (see e.g., Ryder & Yamagata-Lynch, 2014), which led to negotiation processes among stakeholders (mostly students and teachers). A similar observation was made in manuscript 6, where the appropriation of mobile phones by South African nursing students and practitioners triggered tensions which led to the prohibition of phones in the clinical wards. Over time, this development resulted in changes in the overall cultural system. For example, in manuscript 3, the agency of students was enhanced and power relationships in which lecturers were conceived as the gatekeepers of knowledge started to alter. Also, manuscript 5 shows nicely the enhanced – but negotiated - agency of the South African nursing students and practitioners, who, drawing on the appropriation of mobile social media, were able to alter their learning environments. Study participants were not only able to collaboratively build a mobile-based blended learning community that functioned across geographic and temporal boundaries, but also covered diverse social and thematic domains, as well as diverse virtual and on-site interaction zones. Existing learning environments changed in a variety of ways. In addition to temporal factors such as synchronicity and time span, changes in the learning space, degrees of formality in the presentations and general communication, the tool used, prompts, modalities, and the predictability of the learning experience and learning space could also be observed. Connecting to these observations, the appropriation of a Facebook site by Nepalese medical students and doctors (studied in manuscript 4) was also found to trigger a radical and quick transformation of media use and learning practices.

The studies of strand two of the thesis can be also viewed through the lense of boundary crossing. Drawing on the notions of Akkermana and van Eijckb (2013), boundary crossing can refer to “establishing continuity in action or interaction across socio-culturally different sites”. According to Star (1989), boundary objects are linked to specific artifacts which support the crossing by having a bridging function. A classic example used in the literature is an apprentice who bridges the world of school and work (e.g., Akkerman & Bakker, 2012). Similarly, in manuscript 6, the digital media used by the nursing students and practitioners connected the different socio-cultural systems of formal education and workplace learning. One example is students and facilitators who used phones to document work experiences in the form of photographs and shared them in the classroom and at a later point in time. In addition, in manuscript 4, the Facebook site studied could be conceived as a boundary crossing tool, bridging and bringing together elements from diverse socio-cultural systems. Firstly, beyond Nepal, medical students and practitioners from other countries engaged in the site. In similar ways, artifacts from different cultural systems were merged as textbook materials and quizzes from North American settings were introduced and shared in an Asian context. Secondly, the site bridged further socio-cultural systems, primarily bringing together formal and informal learning systems. More precisely, formal learning practices were enacted in a highly informal learning context. Thirdly, it also brought together different socio-cultural systems from a professional perspective, connecting lecturers / medical professionals, students, and occasionally even patients.

However, past events have shown that the boundary-crossing affordances of social media sites such as Facebook are rather’ limited. The algorithms tend to connect socio-cultural systems which are at least (somewhat) similar in nature. This is underpinned by current research on filter bubbles and echo chambers (see e.g., Rhodes, 2022), where, as a commercial strategy, like-minded people are connected at the cost of diversity.

Similarly to the other studies in strand 2, manuscript 5 also makes clear how the use of a social networking site served as a boundary object (Akkerman & Bakker, 2011) between different socio-cultural systems, and, in so doing, created tensions which needed to be negotiated – which reflects the tenets of the cultural historical activity system (Engeström, 2001). The two systems that caused the tensions in this paper were those of social networking and research supervision. In addition, it explores in detail how this dynamic process was shaped by tensions that occurred with respect to different socio-linguistic, social and functional demands linked to these two underlying cultural systems. For example, users, both

supervisors and learners, needed to negotiate between two competing 'languages', namely, the informal and colloquial idiom which is typical for social networking language and mobile phone communication (see e.g., Eisenstein, 2013; Gouws et al., 2011; Thurlow & Brown, 2003) and the more formal language connected to the ways in which research is expected to be articulated.

The way in which the tensions manifested can, in many respects, be viewed as dialectical in nature, as they are not mutually exclusive but require users to address both directions simultaneously (Montgomery, 1993). For example, with respect to social proximity in research supervision, learners and supervisors typically have a degree of social distance, given their different levels of knowledge and authority. This contrasts with typical social media dynamics that favour communication on a peer level. In fact, over time, the observed supervision group developed an increasingly socio-emotional presence and a growing sense of togetherness, which is conceived to be highly relevant in e-supervision (Pachler & Redondo, 2012). In other words, and this is typical when social media is appropriated in educational settings, users need to continually negotiate the tensions of intimacy versus detachment, and between intellectual and social engagement. This is not a decision at a certain point in time but plays out through continuous and ongoing negotiation practices (Montgomery, 1993).

This thesis consists of two main strands: The first strand focuses primarily on examining the extent to which national culture is considered in HCI studies, and the extent to which subjects from different national settings are part of HCI studies. The second strand centres on the examination of the relationship between HCI, particularly in knowledge-intensive practices and cultural and socio-cultural systems. The results from both strands show that the HCI community should consider the diversity of potential technology users in its research and recommendations. Only in this way can technological developments be realised that are globally useful and usable on a broad scale.

For this purpose, based on our results and ideas presented in manuscript 2, several suggestions can be made:

- The diversity of author teams should be enhanced in order to increase the (cultural) diversity of participant samples. We observed that authors often recruited local participant samples (81.23% of the articles recruited participants in the country of the authors' workplace). In other words, increasing the local diversity of the author teams alone, ideally from non-WEIRD and WEIRD countries, could result in more diverse

participant samples. CHI should therefore encourage collaboration between authors from Western and non-Western countries, with a focus on achieving a research goal together and on an equal playing field. Existing initiatives (e.g., Mentis et al., 2018) should be expanded and cooperation with country and geographical areas conferences of the SIGCHI community should be established, e.g. in Asia (Asian CHI Symposium 2022, 2022; CHIuXiD, 2022) or India (India HCI, 2021). Other suggestions include establishing virtual or hybrid conferences and reducing the cost of attendance fees. To some extent, the last two aspects have already been implemented in recent CHI conferences, driven by the efforts of the CHI Steering Committee and SIGCHI-community (CHI Steering Committee, 2021) and also due to the restrictions of the Corona pandemic. For example, in 2021 and 2022, the conferences were held either purely online or in hybrid form (CHI22, 2022a; CHI2021, 2020), and registration fees were reduced, depending on the country of origin of the conference participants (CHI22, 2022b; Quigley & Kitamura, 2021).

- A further improvement in (regional) diversity could be achieved by increasing the use of online study designs (Casler et al., 2013). While approximately 37% of the earth's population does not have Internet access (ITU, 2021), this approach is still a resource-feasible option for recruiting study participants worldwide. With this limitation in mind, further research and initiatives (analogous to Casler et al., 2013; Oppenheimer et al., 2009; Paolacci et al., 2010; Peer et al., 2017; Reinecke & Gajos, 2015) should be initiated and supported to identify measures to ensure data quality in online studies and to identify further research methods in online settings. In addition to methodological aspects, the (further) development of special recruiting and research platforms (e.g., Gaikwad et al., 2015; Keegan et al., 2014; Reinecke & Gajos, 2015) should also be supported.
- In the light of the findings gained, replications of influential studies in a cross-cultural context should be fostered to identify any relevant differences in technology usage and usability in a culturally relevant context. Within the CHI community, efforts are already underway to increase replication of studies (M. L. Wilson et al., 2013).

- In addition to increasing the acquisition of non-Western participant samples, methods suitable for studying these diverse participant samples should also be developed, considered, and shared. For example, Dell et al. (2012) showed that differences in the origin of researchers and study participants can negatively affect the responses obtained. To counteract these phenomena, methods could be adapted to include participants as co-designing partners (Irani et al., 2010). The body of knowledge and experience of CHI researchers regarding the design and conduct of studies in different cultural settings could prove valuable here, and distribution of this knowledge should be promoted accordingly (e.g., through workshops, research papers, or guides).
- The results obtained should be scrutinised for their generalisability, especially with regard to cultural differences and/or the complexity of activity systems. Added value for the assessment of a possible generalisability or transferability would be achieved by providing a detailed description of the investigated participant sample as well as its relation to the total population. The composition of diverse and culturally differently socialised reviewers could also provide added value in the assessment of these factors due to diverse perspectives.
- Ideally, at the CHI, authors should provide comprehensive information on the chosen methodology, the composition and characteristics of the participant samples, and the core elements of their research in order to enable replication and conclusions about possible cultural influencing factors. This is particularly relevant since the results from manuscript 2 showed that more than 56% of the articles in our sample did not include information about the participants' country of origin and that several studies have highlighted the fact that contextual and extensive information about study participants characteristics is often lacking in CHI studies (e.g., Himmelsbach et al., 2019; Schlesinger et al., 2017).
- Given the different meanings of culture (as also shown in the second strand of the work), this concept needs to be more explicitly characterised in the studies. Most of the studies which mentioned culture (see manuscript 1), did not provide a theoretical foundation for this concept.

- In addition to (broad) national cultures, the influence of other, more finely grained (socio-cultural) systems (as outlined in strand 2) should be examined more deeply in HCI.
- Instead of the one-directional view of cultural influence, the recursive ways in which technology appropriation changes cultures (and the other way round) should be considered.

Conclusion and Outlook

Several key conclusions can be drawn: To begin with, the studies in the first strand of this thesis have shown that HCI research tends to neglect culture, or, if it is considered, it is mostly treated narrowly, as a single variable that measures national cultures. The restricted cultural perspective becomes further evident when studying the participant samples from the most relevant HCI conference. There was a strong focus on WEIRD participant samples and most of the other countries were clearly underrepresented. The second strand has shown the rich practices of technology appropriation in study settings outside of the typical WEIRD contexts. It has explored the manifold, rich and often complex ways in which the use of technology is impacted by structures and practices of cultural systems, and, in the same way, transforms these systems. The perspective gained from this thesis is that HCI might conceive and explore culture as a much wider and dynamic concept.

This thesis has shed light on the role of culture and socio-cultural systems and their multi-layered manifestations in HCI research. Many of the presented findings and recommendations provide opportunities for further research. Due to the focus of the analysis in the first manuscript, further research projects should identify whether culture as an influencing variable is often implicitly taken into account although this is not clearly indicated in the articles. This would allow for a much more high-resolution picture of culture orientation in HCI research.

In addition, based on the studies of the second strand, there are implications for future work in HCI research. These should take the interdependencies between technology appropriation and changes in socio-cultural systems more explicitly into account, not only in a one-dimensional approach, but holistically, in order to identify possible recursive interactions. In this context, the use of qualitative research methods to obtain an in-depth understanding of these phenomena – under consideration of the multiple elements of underlying (socio-) cultural systems would be recommendable. The

relationships identified there could be parameterised for increased representativeness and generalisability, as well as comparability to improve the quantitative evidence.

Finally, the ideas proposed in the general discussion on how to increase diversity and the consideration of cultural aspects in HCI research and the HCI community should be further discussed, developed, and tested.

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Curriculum Vitae

Aus Datenschutzgründen entfernt // Removed for privacy reasons

Appendix

1. **Linxen, S.**, Cassau, V., & Sturm, C. (2021). Culture and HCI: A still slowly growing field of research. Findings from a systematic, comparative mapping review. *Proceedings of the XXI International Conference on Human Computer Interaction*, 1–5. https://doi.org/10.1145/3471391.3471421

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Culture and HCI – A still slowly growing field of research. Findings from a systematic, comparative mapping review

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ABSTRACT

Culture is a phenomenon that shapes and conditions outcomes of human-computer interaction in very significant ways. The goal of this study was to analyse the development of the field that studies culture as part of HCI research. To do so, a systematic mapping review was carried out that analyzed articles from seven high profile HCI journals and conference proceedings in 2010, and from 2016 to 2020. The results were then systematically compared to a previous study from Kamppuri et al. [14], which covered the time from 1990 to 2005. The analysis shows a steady increase in the number of articles that consider culture. However, given the importance of culture as a phenomenon, the increase in articles that consider culture from 0.9% in the period of 1990 to 2005 to 1.9% of the articles in the present sample (2010, 2016-2020) is inadequate. There is also room for improvement regarding the limited extent to which culture is linked to underpinning conceptual and theoretical sources. If the HCI community wishes to establish knowledge that is globally more relevant, the concept of culture needs to be studied and articulated much more systematically.

CCS CONCEPTS

• **Human-centered computing → Empirical studies in HCI**.

KEYWORDS

culture, design, HCI, review

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1 INTRODUCTION

The field of human-computer interaction (HCI) does not only consider the specific place and the time when interaction takes places. Drawing on the scholarly definition of Hewett et.al [8], it also includes "the study of major phenomena surrounding" these interactions. With reference to Newell's well established Time Scales of Human Action [16], one could argue that the cognitive band (covering actions from 100 milliseconds to 10 seconds) and the rational band (covering a range from minutes to hours) would be the points of reference for the study of concrete interaction while the social and historical bands (days to months to years) reflect the surrounding phenomena, which would include culture.

Many empirical studies provide strong evidence that concepts such as (national) culture play a role in the use and design of human-computer systems (e.g. [5, 6, 20]). For example, users' national culture can affect their search efficiency on websites [2] and it can influence their participation in Q&A websites [17]. The usage of design attributes of websites can vary between cultures [1] or the subjective usability ratings can differ depending on the national culture of participant samples [19].

The above definition of HCI, the definition of time scales embracing social and cultural aspects, and the empirical basis that shows how culture influences HCI systems make it clear why concepts of culture have found their way into major HCI conferences and journals. Three decades after the development of these definitions, it is time to revisit the importance that the notion of culture takes in HCI research.

By quantifying culture-related publications in mayor HCI journals between 1990 and 2005, Kamppuri et al. [14] made a first attempt in 2006 to examine the relevance and frequency that this topic has in the HCI community. They looked specifically into the categories general information, technology, research methodology, and sources of cultural theory.

The goal of this paper is to follow up on Kamppuri's work by reviewing the same categories. Given the conceptual and empirical importance of culture as one of the phenomena surrounding HCI, we ask whether there is a notable change regarding how culture is treated in major scientific outlets?

2 METHOD

To evaluate the status quo of culture-based studies in HCI research and its development over time, we conducted a systematic quantitative content analysis of full articles published in seven major HCI publication formats, carrying out a systematic, comparative mapping review. To cover an extended period of time in the analysis, we also used the results of the Kamppuri et al. [14] study as a basis of comparison, who, as indicated above, published a review in 2006 on the "occurrence and characteristics of the studies of culture in HCI" over a 16-year time span (1990-2005).

*Sebastian Linxen and Christian Sturm contributed equally to this research.

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2.1 Dataset

For reasons of comparability, we used the same five publication formats (1-5) as Kamppuri et al. [14] for our analysis, but added two more journals (6-7) to this list to cover an even broader field of HCI research publications. Our dataset contained full articles from the following seven major HCI platforms for the year 2010 and for the period 2016-2020: (1) Human-Computer Interaction (JHCI) [10], (2) International Journal of Human-Computer Interaction (IJHCI) [13] , (3) International Journal of Human-Computer Studies (IJHCS) [13], (4) Interacting with Computers (IWC) [12], (5) ACM CHI Conference (CHI) [4], (6) Behaviour & Information Technology (TBIT) [3] as well as (7) ACM Transactions on Computer-Human Interaction (ToCHI) [21].

We selected the previous five years (2016-2020) to identify the current status as well as recent trends and developments regarding the extent to which culture is considered in HCI research. Due to the intended comparison with the analysis of Kamppuri et al. [14], we also analyzed the publications from the year 2010 for all seven publication forms. Through this snapshot, developments that took place between 2005 and 2016 can be investigated and a consideration of the overall development is possible.

The search yielded a total of 5669 articles from the seven journals/proceedings listed for the years 2010 and 2016-2020, which were selected for further analysis.

Following Kamppuri's et al. [14] approach, one author scanned this sample and excluded all articles that did not use the term "culture" or "cultural" in the title, abstract, or keywords. Articles that did not define culture in terms of ethnic or national culture (but rather, for example, in terms of organizational culture) were also removed from the sample.

To ensure data quality, consistency and inter-rater reliability, 5% (n=284) of the articles were randomly rechecked by another member of the author team. The results showed an inter-rater agreement of the two independent raters of 98.6% which indicates low levels of subjectivity.

The application of the above-mentioned eligibility criteria resulted in a final data set of 109 articles (1.9% of the original sample), which was examined more closely (see www.linxen.com/I2021/am1.pdf for a list of the selected publications).

2.2 Analysis

By using an adapted version of the coding scheme developed by Kamppuri et al. [14] (see www.linxen.com/I2021/am2.pdf for the detailed coding scheme) two of the authors scanned the 109 articles of the final sample independently and extracted relevant information. By adopting inductive principles of qualitative data analysis based on the approach of Pope et al. [18] the reliability of the results was improved. In cases of uncertainties regarding the interpretation of information (e.g., type of technology used), these two authors discussed the case until consensus was reached.

In the second step, the extracted information was compared with the results of the study by Kamppuri et al. [14], who collected similar information for the period of 1990-2005. The total sample of their study included 3286 full-length articles. 28 culture-related articles (0.9% of the full sample) were then selected for the final analysis.

3 RESULTS

3.1 Cultural Studies by Source and Year

Analysis period 2010, 2016-2020: Over the period of 2010 and 2016-2020, we found that the number of articles dealing with culture increased steadily (see Figure 1). Although the direct comparison of the years 2010 and 2016 shows no increase (12 articles in each year), the number of relevant articles increased permanently from 2016 to 2020 (apart from two minimal drops in 2018 and 2019). In 2020, the number of relevant articles more than doubled compared to 2010 (from 12 to 26 articles). A notable observation is that CHI is the platform that publishes the highest number of culture-related articles out of all the analyzed media, with 58 (53.21%) out of 109 articles. CHI is followed by IJHCS with 19 articles (17.43%) and, after that, by IJHCI with 13 articles (11.92%). JHCI published the smallest number of articles related to culture, with only one article (0.91%).

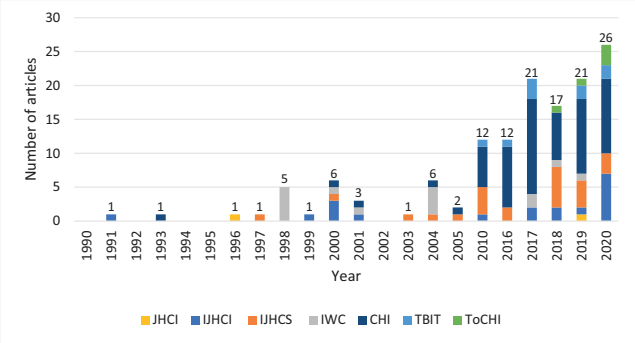

Figure 1: Culture-related articles per year and publication based on Kamppuri et al. [14] (1990-2005) and own analysis (2010, 2016-2020)

However, these numbers need to be put into perspective by comparing them with the total number of articles published in the respective outlets (see Table 1). For example, only 1.6% (n=58) of the CHI publications explicitly deal with cultural aspects in contrast to 3.7% (n=19) of all IJHCS articles. While the IJHCS tops the list of this relative comparison, the JHCI had only one paper (1.3% of all articles published there) in the six years considered. Of the total 5669 articles examined in our sample, 1.9% (n=109) addressed cultural factors.

Comparison with the period 1990-2005: Kamppuri et al. [14] identified 28 articles that addressed the topic of culture in the 16-year period they studied (1990-2005). In the 6 years we studied (2010 and 2016-2020), the same scientific outlets published 95 relevant articles. While the IWC was the journal with the most publications with cultural references during the period studied by Kamppuri et al. (n=11), it contributed only 4 articles to our sample, making IWC the journal that published the second fewest number of articles in the field. Most striking is the advance of CHI, which published five articles from 1990-2005 but accounted for 53.2% (n=58) of the culture-related papers in the overall sample during our study period.

Table 1: Overview of all published articles by number (total and culture-related) and percentages of culture-related articles

Journals and proceedings	$n_{papertotal}$	$n_{paperculture}$	$\%_{paperculture}$
JHCI	78	1	1.3
IJHCI	582	13	2.2
IJHCS	513	19	3.7
IWC	244	4	1.6
CHI	3571	58	1.6
TBIT	479	9	1.9
ToCHI	202	5	2.5
Total	5669	109	1.9

3.2 Technological Areas of the Studies

Analysis period 2010, 2016-2020: Following Kamppuri's et al. [14] approach, we classified the articles according to their technological areas (see Table 2). This showed that about 38.5% (n=42) of the articles dealt with topics related to general design issues. 17 articles (15.6%) addressed interface agents and about 25.7% (n=28) of our sample dealt with topics that could not be clearly assigned to the defined technological areas.

Comparison with the period 1990-2005: In comparison with the data from 1990 to 2005, it can be seen that design areas continue to have a similarly high significance (39.2% vs. 38.5%). The topic area Interface Agents has gained in importance in the current analysis, while the remaining areas (www, groupware and embedded systems) have declined. It is notable that many studies (25.7%) were assigned to the category "other" in our analysis. This was due to the fact that it was often not possible to clearly distinguish them from the remaining areas.

Table 2: Technological areas of the studies

	1990-2005		2010, 2016-2020	
Technological area	$n_{paperculture}$	%	$n_{paperculture}$	%
Design	11	39.2	42	38.5
WWW	5	17.8	15	13.8
Groupware	5	17.8	6	5.5
Embedded systems	4	14.3	1	0.9
Interface agents	2	7.1	17	15.6
Other	1	3.6	28	25.7
Total	28	100	109	100

3.3 The Conceptualisation of Culture and Research Approaches

Analysis period 2010, 2016-2020: The analysis of the articles revealed that 28.4% (n=31) examined culture as a user characteristic. Kamppuri et al. [14] classified this form of culture as influencing "the users' cognitive style, attitudes towards technology or the meaning they give to representations". Approaches that assessed the cultural context of the user were represented in 41 articles (37.6%). In contrast, there were only 11 articles that examined culture as a larger system (10%).

Regarding the research design, the most commonly used research methods were questionnaires (n=30, 27.5%), followed by experiments (n=25, 22.9%) and interviews (n=24, 22%). Several articles used mixed methods or other designs (n=30, 27.5%).

Just over half of the papers used quantitative research methods such as questionnaires and experiments. Qualitative interviews were only used by about one fifth of research projects.

Comparison with the period 1990-2005: While 57% of the studies in Kamppuri's et. al [14] research period considered culture as a characteristic of a user and the other two approaches each made up 18%, we found a more differentiated picture. The distribution in our sample showed that studies that considered the cultural context of a user were most common (37.6%), followed by articles which observed user characteristics (28.4%).

In comparison with the studies of the period 1990-2005, the use of different research methods was more evenly distributed in our sample. While in Kamppuri et al. [14] questionnaires were the most common type of research (44%), our analysis showed that questionnaires, experiments and interviews were almost all used with similar frequency. The many mixed methods approaches used in our sample resulted in the significant increase of studies in the the category "other".

3.4 Coverage of Countries

Analysis period 2010, 2016-2020: In 84 of the articles in our sample we were able to clearly assign participants in the respective studies to their countries. In total, 29.274 individuals from 44 countries were represented. The four most common national cultures studied were: US-American (n=34), Chinese (n=17), British (n=12), and South Korean (n=9) (see www.linxen.com/I2021/am3.pdf for the 10 most frequently represented countries). 38.1% (n=32) of the studies examined more than one (national) cultural population.

Comparison with the period 1990-2005: While 44 countries were identified in our sample, 24 countries were examined in the 16-year period covered by Kamppuri et al.. The most frequently studied national cultures were (US-)American (n=10, 41.6%), Chinese (n=5, 20.8%), Japanese (n=4, 16.6%) and German (n=4, 16.6%).

Compared to our data set, it can be observed that the US continues to be one of the most studied national cultures, but it is noteworthy that the range of national cultures studied has increased. While four national cultures account for 95.6% of the total sample in the 1990-2005 period, the number of national cultures represented is much higher in the 2010, 2016-2020 study period. Here the top four national cultures accounted for "only" for 45% of the sample.

3.5 Theoretical underpinning

Each research paper on culture is supposed to define the basic concept of culture. There is, however, no universal definition, which results in a great variety of underlying sources.

Analysis time period 2010, 2016-2020: 50 out of 109 papers do not refer to any specific concept or theory of culture. In the studies that

provided a cultural underpinning, most conceptualisations were based on approaches borrowed from sociology and psychology. Some papers use post-colonial theories and theories from management literature. Culture was predominantly referred to as a national characteristic. This tendency has shifted over time, including additional characteristics in the definition of culture.

Hofstede dominates the theoretical frameworks. One third of the papers use his definition of culture as "software of the mind" [9]. 15 out of 61 cited Hofstede directly. Literature on cultural heritage is found to be the theoretical foundation for 10 papers, while 3 publications focus on artefacts in the form of cultural probes. Only half of the papers refer to peer-reviewed sources to define their concept of culture. 26 out of 61 papers used books.

Comparison with the period 1990-2005: The number of papers that include the concept of culture without making reference to a specific theory or concept increased from 40% to 45%. Hofstede continues to be the most used source in this type of research.

4 DISCUSSION

Our aim was to evaluate systematically current developments in seven HCI publication channels regarding the thematic engagement with national and ethnic cultural aspects, 15 years after the Kamppuri et. al study. For this purpose, we screened 5669 articles from 2010 and 2016-2020 and went on to analyze 109 articles in detail that addressed cultural aspects. The findings of the present sample (2010, 2016-2020) were also compared to the results of Kamppuri et al's [14] work to permit an analysis over an even larger time span.

A modest positive development is not only the steady increase in the number of culture-related publications during the analysis period, but also the fact that this increase is also reflected in the percentage values, despite a larger overall sample. While 0.9% of the articles were culture-related in the analysis period of 1990-2005, this number was 1.9% in the analysis period of the current study. These general trends and specific points, such as the fact that the 2019 (n=21) and 2020 (n=26) publications contain in total more culture-related articles than the entire 1990-2005 period, shows that the HCI community has developed an increased interest in cultural topics, which remains, however still at a modest level.

This positive development in the journals and proceedings analyzed is supported by a variety of specialized publication formats and conferences within the HCI community, such as ICTD [11] and HCIXB [7]. The articles published there and in workshop and symposia proceedings would further enhance the figures we have calculated. It can be assumed that many authors exchange and publish culturally relevant topics in these specialized forums.

With regard to the technological areas of the studies, it was found that design topics were addressed predominantly across the two comparison periods studied. It was also notable that it was often not possible to clearly assign the technological areas in the articles of the more recent period, which can also be explained by more complex and interlinked technological developments and the multidimensional areas of research.

The research approaches are more evenly distributed in the present sample than in the period studied by Kamppuri et al.. However, quantitative methods are still used predominantly, i.e. by 50% of the articles, although a more pronounced increase in qualitative methods might have been expected with regard to the desirable in-depth exploration of culture. Interestingly, there was also a shift in the form in which culture was viewed and studied. In the present sample, the focus is no longer only on the cultural context of a user, but also on culture as a characteristic of a user.

The increase in countries studied and the more equal geographical distribution of articles is of course positive. However, the fact that still a relatively small number of nations make up a large part of the sample limits the generalizability of the entire field. It is thus paramount to further increase diversity and include culturally more diverse participant samples.

It is surprising to see that the theoretical sources which conceptualize culture are (still) not included in a large part of the sample. This might be explained by the complexity of the definitions of culture: Every discipline has developed a multiplicity of diverse and sometimes disparate perspectives which complicates the empirical engagement with the phenomenon. In some papers culture appears to be seen as "common to everyone" and universally understood - mostly as a concept of national culture. In any case, neglecting the complexity of culture is an omission that might lead to oversimplified accounts which do little to advance the field.

5 LIMITATIONS AND FUTURE WORK

Our approach was systematic but limited in its scope. We focused exclusively on the terms "culture" and "cultural". It might be possible that this approach excluded papers that dealt with cultural aspects and influencing factors without explicitly declaring them as such in the title, abstract or keywords.

A recently published study [15] on the origin of study participant samples at the CHI conference showed that they came from over 93 countries and that various studies included participants from different nations and cultural backgrounds. Therefore, the number of articles that address cultural factors indirectly could be much higher. Future studies that focus on similar investigations might thus extend their research criteria in order to obtain an even more comprehensive picture of the situation. However, it needs to be acknowledged that the analysis of studies in which culture is not considered directly is much more difficult and possibly prone to bias. Accordingly, authors of studies in which cultural aspects are likely to shape the outcomes, especially in settings where cross-cultural comparisons are possible, should explicitly consider this in the study design and label it to further increase the visibility of this important research area.

6 CONCLUSION

Considering the study of culture in relevant articles in HCI journals and conference proceedings, a steady increase is notable. However, given the importance of culture as a phenomenon that shapes and conditions outcomes of HCI in very significant ways, the increase in articles that address culture from 0.9% in the period of between 1990 to 2005 to 1.9% of the articles in the present sample (2010, 2016-2020) is inadequate. Room for improvement can also be seen in the limited extent to which culture is linked to underpinning conceptual and theoretical sources. If the HCI community wants to develop findings that are more globally relevant, the notion of culture needs to be studied and articulated much more systematically.

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How WEIRD is CHI?

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ABSTRACT

Computer technology is often designed in technology hubs in Western countries, invariably making it "WEIRD", because it is based on the intuition, knowledge, and values of people who are **W**estern, **E**ducated, **I**ndustrialized, **R**ich, and **D**emocratic. Developing technology that is universally useful and engaging requires knowledge about members of WEIRD and non-WEIRD societies alike. In other words, it requires us, the CHI community, to generate this knowledge by studying representative participant samples. To find out to what extent CHI participant samples are from Western societies, we analyzed papers published in the CHI proceedings between 2016-2020. Our findings show that 73% of CHI study findings are based on Western participant samples, representing less than 12% of the world's population. Furthermore, we show that most participant samples at CHI tend to come from industrialized, rich, and democratic countries with generally highly educated populations. Encouragingly, recent years have seen a slight increase in non-Western samples and those that include several countries. We discuss suggestions for further broadening the international representation of CHI participant samples.

CCS CONCEPTS

• **Human-centered computing → Empirical studies in HCI**.

KEYWORDS

WEIRD, sample bias, generalizability, HCI research, geographic diversity

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1 INTRODUCTION

CHI is widely regarded as the premier venue for Human-Computer Interaction, often influencing technology innovations that were inspired by its publications on the design and use of computer technology. Such technology innovations are being used by increasingly large numbers of people from diverse countries around the world. Commonly, the research findings produced by the CHI community that are driving such innovations may be assumed to be universally applicable to the entire human population.

However, CHI is not as international as the users of technology are. In fact, the SIGCHI Executive Committee has made it one of its key missions to 'foster' HCI growth around the world" [59], recognizing that its members, including those who contribute research to CHI, are primarily from North America and Europe.

Growing HCI around the world will be especially needed given that we are only beginning to understand how people differ in their use and acceptance of technology. Prior work in HCI has started to show that people's use and perception of technology varies across countries and (national) cultures (e.g., [64, 70]). To name only a few examples, a user's country of origin can affect their interaction with MOOCs [33], people from richer countries tend to be more likely to schedule meetings online, but tend to be less likely to find mutually agreeable times, than people from less affluent countries [72], a person's country of origin can influence the adoption of smartwatches [28], and a person's culture can affect their trust in specific website designs [20]. This past work suggests that many of the findings about the design of technology that we have accumulated over many years of studying largely Western samples may not generalize to other countries and cultures.

A factor contributing to this problem is that researchers in HCI are predominantly located in Western countries [5, 57], which suggests that the majority of samples likely consist of Westerners. That the lack of geographic diversity in both authors and participants of published articles is a problem has been widely recognized in the behavioral sciences. For example, already in 1984 Triandis and Brislin [87] pointed out the relevance of cross-cultural studies and that not only highly industrialized nations should be studied, but also societies with different technological developments and different forms of political organization. In 1999, Sue [82] raised the need to cross-validate principles and measures with different populations

and ethnicities. In 2008, Arnett [3] published an empirical analysis of the prevalence of US American authors and participants in APA Journals, concluding that contributors, samples, and editorial leadership of the journals are predominantly US American, neglecting 95% of the world's population. Henrich and colleagues [36] showed in 2010 that US American participants are frequent outliers when compared to the rest of humanity because they skew white and affluent. US American participants (commonly undergraduates recruited through universities' psychology subject pools [3]) are common outliers on many psychological measures [36]. According to Henrich et al., this makes these participants "the WEIRDest people in the world" [36], an acronym for Western, Educated, Industrialized, Rich, and Democratic. Research findings based on studies with these participants may not be generalizable, despite a common assumption that published findings apply to all human beings.

Henrich et al.'s article on WEIRD subjects demonstrates that the oversampling of American undergraduates in the behavioral sciences impacts studies' external validity (i.e., whether findings can be generalized to another context) and has triggered widespread calls for studying more diverse samples and replicating prior studies in other contexts (e.g., [62, 74]), and in particular in non-Western countries [44, 94]. Similar discussions have been started in the CHI community, such as in workshops and symposia discussing the generalizability of findings [52, 73, 81, 98]. In this paper, our goal is to further these discussions by answering the following main research questions: (1) To what extent are participant samples in CHI papers from Western, Educated, Industrialized, Rich, or Democratic societies?; and (2) Which countries are over- and understudied?

As such, we are primarily interested in characterizing the international breadth of HCI samples. HCI researchers have certainly studied non-traditional samples in Western countries, such as people of low income [9, 27, 95], or people with different ethnicities [29, 56, 84]. These studies are invaluable for understanding the diversity of people within Western countries where large parts of the population do not correspond to the typical undergraduate student that Henrich et al. referred to as "WEIRD participants" [36]. Our focus instead lies on identifying in which countries HCI participant samples are being recruited in and whether these countries, overall, tend to be more Western, Educated, Industrialized, Rich, or Democratic.

To analyze the international breadth of CHI, we conducted a systematic content analysis of all papers included in the CHI proceedings between 2016 and 2020. Following previous call-to-action papers published at CHI (e.g., on intersectionality [78]), we chose the WEIRD acronym developed by Henrich et al. [36] in 2010 as a framework for assessing the percentage of participant samples from Western, Educated, Industrialized, Rich, or Democratic societies. The choice enables us to compare results with the field of psychology, where a similar framework has previously been applied [3]. However, it is important to note that such frameworks tend to oversimplify. In the case of Henrich et al.'s WEIRD acronym, it should be especially emphasized that countries do not consist of homogeneous populations. People within the same country can be highly diverse; not everyone in Western countries, for example, enjoys a high education and income level. Other identities, such as class, sexuality, or race, also vary across a country's population. The WEIRD framework ignores these nuances and instead focuses mainly on the differentiation between Westerners and the rest of the world. In our work, we go beyond this binary classification of the world by analyzing both the combination of all WEIRD variables and each WEIRD variable individually. By looking at each WEIRD variable separately, we reveal which societies that CHI study participants come from *tend* to be more Western, educated, industrialized, rich, OR democratic, rather than making broader claims.

Our contributions are as follows:

(1) We provide the first empirical analysis of the degree of geographic breadth of CHI participant samples, showing that at least 73% of CHI study findings in the past five proceedings are based on Western participant samples. While the past two years have seen slight gains in the number of non-Western participant samples, CHI is studying and designing technology for 11.8% of the world's population. More than half of the world's countries (102) have not seen their people being studied over the past five years.
(2) Our analysis also revealed that most participant samples at CHI tend to come from industrialized, rich and democratic countries with generally highly educated populations. While only a third of all papers described the education of their participants, those that did suggest that around 70% of CHI study participants are college-educated.
(3) We provide empirical insights into current practices of describing the identity of CHI study participants and the composition of samples. Our results show that detailed information about participants' country is mentioned only in 39% of CHI papers, and rarely if samples can be assumed to be in the US.
(4) Based on our results, we provide actionable suggestions for broadening the diversity of participant samples, including ideas for facilitating recruitment of non-Western samples, and tracking the international representation of participants in the future.
(5) We also make available our data set compiled from our systematic content analysis of the CHI proceedings between 2016-2020, which can be used for the replication of our results, answering additional research questions, and for developing strategies to increase geographic diversity.

2 RELATED WORK

Sample size, diversity and generalizability. Researchers strive to ensure that the conclusions drawn from participants in their experiments generalize to those who did not participate. Key methodological factors that influence this generalizability are the sample size (coupled with participants' diversity), and the representativeness of participants (e.g., as influenced by sample bias).

Small sample sizes have been increasingly dismissed as insufficiently representative of a general population. A typical sample size of 40 subjects (as found by Marszalek at al. in 2011 [58] for conventional laboratory studies) means that these studies are often underpowered and fail to replicate [4]. This is because low sample sizes provide only an extremely rough estimate of the population, one that is far too noisy to reliably detect typically-sized effects. But even larger sample sizes can fail to ensure the representativeness of participants. Arnett [3], for example, showed that, independent of sample size, most findings in the field of psychology are based on

American undergraduate students, which tend to be more affluent, and are more likely to be white, than the general U.S. population (and much more so than the average person in the world). In addition Henrich et al. found that results drawn from North-American student samples often do not generalize across cultures and demographics [36]. The so-called WEIRD samples [36]—participants who come from Western, educated, industrialized, rich, and democratic societies—have frequently been found to be outliers when compared to those from other countries.

While the field of psychology has been at the forefront of the discussion around such biased samples, HCI researchers have raised similar concerns. For example, Bartneck and Hu [5] stated in 2009 that "only 7.8% of countries are responsible for 80% of papers in the CHI proceedings". In addition, they found that "nearly 80 percent of all credits go to traditionally English-speaking countries (USA, UK, Canada, Ireland, Australia, New Zealand)" [5]. Similarly, Mannocci et. al. [57] identified an unequal global distribution of publications within both CHI and the International Journal of Human-Computer Studies. They concluded that "there are a number of countries that show a very high level of interest in what is happening in IJHCS and HCI but are unable to have a significant publishing presence or citation impact in these outlets." Todi [86] confirmed these distributions by publishing the general statistics of CHI conferences between 2014 and 2019. Sakamoto [75] presented similar results specifically for Asian researchers at CHI conferences.

While this prior work focused on the global distribution of authors, we contribute an analysis of the global distribution and representativeness of participant samples. In addition, we extend this prior work by analyzing dimensions of the WEIRD acronym that have previously not been analyzed, namely whether participants come from countries that are more educated, industrialized, rich, or democratic compared to the average world population.

CHI efforts to foster replicability and generalizability. Over the last decade, CHI has seen a significant number of activities that underline the recognition that considering diverse user characteristics, ensuring generalizability of HCI research results, and including previously not-included groups of researchers and participants is important. In 2011, Wilson and colleagues started the initiative RepliCHI with a panel followed by several workshops with the focus on the "solid foundations" of HCI research by replicating studies in various forms [96–99]. In 2015, Sturm et al. [81] organized a WEIRD-workshop at CHI to identify HCI studies that might be "unlikely to apply to users in other countries and cultures." Kumar and colleagues [48–52] have been coordinating "HCI Across Borders" workshops and symposia at CHI since 2016 with the aim of including under-served communities and diverse populations into the CHI community. During their workshop "CHInclusion" at CHI 2019, Strohmayer et al. [80] focused on "social and community issues, as well as various grassroots communities".

The importance of broadening the diversity at CHI has also been recognized by the SIGCHI Executive Committee, which has defined five strategic initiatives based on the community's concerns [59]. Three out of the five initiatives focus on the diverse demographics and characteristics that need to be taken into account to represent our community on a global level. Our aim with this paper is to provide the numbers that enable the CHI community to make progress on this front.

Diversity information in papers. To enable the gathering of such data, and to better understand the potential limitations on external validity of specific samples, it is of course required that authors provide such details about their participants. However, this is often not the case. Researchers have been found understate their subjects' identities to simplify the communication of findings and to strengthen the notion that their finding may be generalizable [21]. For example, Himmelsbach et al. [37] reported that in 2016, an average of 2.78 out of 16 different diversity dimensions (age, ethnicity & culture, gender & sex, mental abilities, physical abilities, race, sexual orientation, appearance & body, class, education, geographic, location, language & accent, migration, biographies, parental status, relationship status and religion) were mentioned in CHI papers. While this number increased between 2006, 2011, and 2016, it shows that much contextual information about the study participants is missing from papers. Schlesinger et al. [78] identified 140 (out of 13,999) CHI publications (papers, notes, alt.chi) between 1982 and 2016 that contain at least some level of study participants' identity description. The selection was based on 50 keywords assigned to the categories of "gender, race and class". They suggested to more consistently report contexts, demographics, and limitations based on identity for both authors and study participants. Our work extends theirs by quantifying how often CHI papers report on participant numbers, their country of origin, income levels, and education.

3 METHOD

To evaluate the geographic diversity of CHI participant samples, we conducted a systematic quantitative content analysis of the proceedings of the CHI Conferences on Human Factors in Computing Systems during the years 2016 to 2020. To enable comparison to related work in other fields (e.g., to [3]), we used the WEIRD acronym developed by Henrich et al. [36] in 2010 as a framework to determine if and to what extent participant samples in recent proceedings of the CHI were Western, Educated, Industrialized, Rich, or Democratic. For a nuanced perspective, our analysis primarily focused on each factor individually (treating it like an OR logical operator), though we additionally analyzed how many participant samples came from countries that are considered WEIRD if using AND as a logical operator.

3.1 Dataset

We selected the five most recent proceedings of the CHI Conference on Human Factors in Computing Systems from 2016 to 2020 [11–14, 16], containing a total of 3,269 articles. Analyzing five years of CHI proceedings ensures that our analysis covers representative trends in the CHI community, including potential variations due to conference location. We focused on the CHI proceedings because the venue is the most prestigious in the field of HCI [15], widely quoted [1, 79], has the highest impact factor among HCI venues (H5-index of 95 as of September 2020 [79]), and is considered to be highly influential for new technology developments in scientific and practical communities. Other venues and journals, such as Asian CHI [83] or ToCHI [85] likely show other patterns; our results therefore need to be seen in the context of CHI only.

Table 1: The coding scheme used to extract variables of interest from all CHI papers between 2016-2020. The full dataset can be accessed in the supplementary materials.

Focus	Variable
General information	Title, year of publication
Method	Study method
Author information	Name, place of affiliation, affiliation
Participant information	Place of residence, education, income

3.2 Analysis

Our quantitative content analysis was conducted by instrumenting the WEIRD acronym as follows:

Western: We estimated the influence of Western countries by classifying participant countries, derived from the methods section of each paper, into Western and non-Western using the classification of Huntington [42]. All countries of the European Union [89] were classified as Western countries. A list with the categorization of the countries can be found in the supplementary materials.

Educated: To address the educational level of the participant samples, we used two different approaches. (a) To determine differences in the average educational level of participant samples, we used the mean years of schooling per person per country [63, 92] for our calculations. (b) In addition, we also collected specific information on the educational level of participants wherever available and if the information provided in a paper was transferable to the International Standard Classification of Education (ISCED) [88]. This was the case for 667 papers (n=149,068).

Industrialized: Since industrialization is typically estimated at a country-level (rather than at an individual level), we used GDP per capita [31] (gross domestic product per capita) as an indicator of industrialization for each country. The GDP is regarded as the most influential characteristic for assessing the development and progress of a national economy [55]. To adjust for differences in purchasing power between countries we applied purchasing power parities (PPP) in Int$.

Rich: To determine participant wealth we used a two step approach. (a) We used participant countries' GNI per capita [32] (gross national income per capita, PPP, Int$) to approximate participant wealth. This value reflects all of the income within an economy, accounts for monetary flows in and out of a country, and approximates people's standard of living. (b) We additionally collected participant income information from the methods sections wherever available.

Democratic: We used the political rights rating [39] to determine countries' degrees of democracy. The term "political rights" covers democratic categories like electoral process, political pluralism and participation, as well as functioning of government [40].

Development of coding scheme: Because information about participants is difficult to extract automatically due to varying use of language, we decided to manually extract information from the papers. To develop a coding scheme, all authors first decided on a set of variables of interest. One author then analyzed 100 randomly selected articles to establish the types of information that can be extracted about participants and participant samples, and also about the paper authors since we were interested in analyzing to what extent HCI researchers usually recruit locally. All authors reviewed and discussed the coding scheme and variables extracted from the first 100 articles. The final coding scheme with all variables is shown in Table 1. One author then analyzed a total sample of 3,269 articles and excluded 501 articles that did not report on a human subjects study. The final dataset includes 2768 articles (84.7% of the 2016-2020 CHI proceedings). In parallel, a second author analysed 5% (n=139) of the articles to ensure consistency and to minimize inter-rater effects. The inter-rater reliability was κ = 0.947 – 0.986 ($p < .001$), 95% CI (0.87 – 0.98, 1.00). A Kappa value of .8 or higher is "almost perfect" according to Landis and Koch [53], indicating that there was little subjectivity in extracting the information.

Normalizing by Country Population: The number of participants and participant samples do not indicate whether a country is over-represented or under-represented in the CHI proceedings compared to its population size. To answer our second research question, we therefore normalized the number of participants (ϕ) and participant samples (σ) by their country population using population figures provided by the United Nations [91].

More specifically, we calculated ψ_p, the participants ratio and ψ_s, the participant samples ratio by calculating:

$$\psi = \frac{\#\text{ of } \phi \text{ or } \sigma \text{ (country)} \cdot \text{population (worldwide)}}{\#\text{ of } \phi \text{ or } \sigma \text{ (total)} \cdot \text{population (country)}}$$

Here, a value of 1 corresponds to a participant/sample number proportional to the country's population. A ratio above 1 means that the country is over-represented, while a ratio below 1 means the country is under-represented. For example, a ratio of 0.5 means that only half as many participants/samples from this country were observed than expected relative to the country's population. A ratio of 2 depicts the opposite: twice as many participants/samples from this country were observed than expected in relation to the country's population.

To check if and to what extent CHI participant samples tend to be from educated, industrialized, rich, or democratic countries, we correlated ψ_s with the indicators defined above (e.g. mean years of schooling, GDP). Since some of these variables were not normally distributed and the individual variables were non-linear, robust Kendall's tau [46] rank correlation was used for all correlational analyses (see Table 2 for an overview).

4 RESULTS

We found that 2,768 papers in the past five years of CHI reported on a human subjects study. Of these, 2,611 papers (94.3%) reported on the number of study participants (n=1,134,282); the remaining 5.7% did not specify participant numbers. Only 1,076 papers (38.9%) explicitly mentioned participants' country affiliation or allowed to have it inferred from the author affiliation (e.g., if the recruitment

Table 2: Kendall rank correlations of the participant samples ratio ψ_s with measures of Educated, Industrialized, Rich, Democratic. $n_{country}$ differs due to available data per country. LL and UL indicate the lower and upper limits of a bootstrapped confidence interval (10,000 replicates). Significance levels: *p <.05, **p <.01, ***p <.001.

	Samples		
Variable	r_τ	95% CI r_τ [LL, UL]	$n_{country}$
Educated	.46***	[.341, .593]	93
Industrialized	.50***	[.397, .624]	91
Rich	.50***	[.386, .623]	90
Democratic	.50***	[.381, .619]	93

Table 3: Western and non-Western participant samples. A single paper can report multiple samples. M_ψ shows the average ratio, Mdn_ψ represents the median.

	Samples			
Variable	n	%	M_ψ	Mdn_ψ
Western	1,102	73.13	5.92	5.72
Non-Western	405	26.87	1.62	0.45
Total	1507	100		

description referred to "local university" and all authors were at institutions in the same country). The following analysis is based on the 1,076 papers for which we had information about the country.

4.1 Western

Our findings show that, averaged across the past five proceedings, a large majority of CHI papers involve Western participant samples (73.13%, n=1,102 participant samples - see Table 3), recruited from a total of 31 Western countries. This is a conservative estimate, given that we only included papers that reported on the country of their participants or for which we were able to infer participants' countries.

Figure 1 shows a slight downward trend for Western samples. In line with this, the percentage of non-Western participant samples almost doubled between 2016 and 2020 (from 16.31% to 30.24%).

Figure 1 also shows that the stark increase in non-Western participant samples can be attributed to the fact that the percentage of US samples has significantly dropped from 43.56% in 2018 to 27.96% in 2019 (where CHI was held in the UK) and to 24.84% in 2020 (where CHI was to be held in Hawaii, before the COVID-19 pandemic forced it to go virtual). This suggests that CHI authors increasingly recruit study participants from other countries than the US and also increasingly study samples from multiple countries.

Which countries are over- and understudied? Table 4 provides an overview of the top 10 countries of participants by actual numbers (left column), and by participant samples (middle and right column, sorted by ratio and by number of samples, respectively). We include both of these because they show two different results: The actual participant numbers, counting each participant and their country

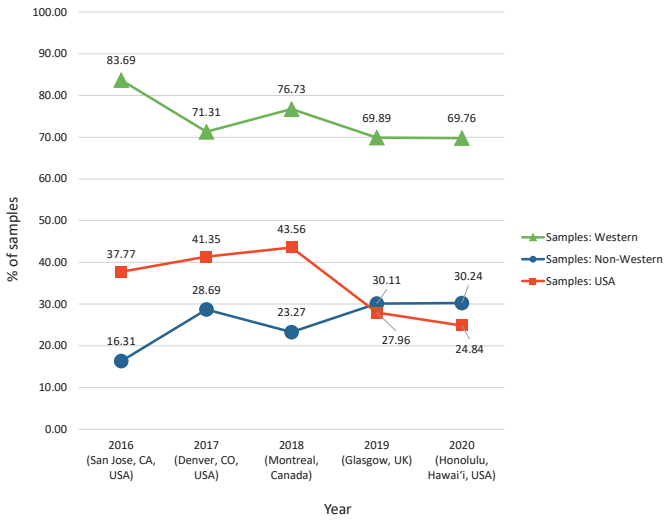

Figure 1: Proportion of CHI Western-, non-Western and US participant samples, 2016-2020 plus conference locations.

affiliation individually, show that Western participants are strongly over-represented when compared to the world's population. For example, participants from the US account for 54.84% of all CHI study participants although they only account for 4.25% of the world's population (hence, a high participant ratio of ψ_p=12.91). The columns in the middle and on the right in Table 4, showing the countries of overall samples, give us a better feel for how many *findings* are based on Western participant samples. US samples account for 45.82% of all participant samples, samples from Great Britain for an additional 15.71%, followed by German samples with 8.74%.

While most participant samples are recruited in the US, the US is not the most over-represented country at CHI. As the middle columns in Table 4 show, 18 participant samples were from Finland, which means that findings based on Finnish samples were strongly over-represented with respect to the world's population (ψ_s=16.80). Naturally, countries with small population sizes are found in the top 10 of this table, such as Finland, Luxembourg, Switzerland, Denmark, and even St. Lucia or Bhutan. The USA would appear only in place 12 in this ranking.

As a next step, we set out to analyze how the countries of participant samples are geographically distributed and which countries and regions may be understudied. Figure 2 shows the worldwide distribution of participant samples relative to the country population (countries by ratio). While participants in CHI studies between 2016 and 2020 came from 93 countries, large numbers of countries are completely missing from this map, especially in Africa, but also in Central and South America, Europe, the middle East, and Central and South Asia. More precisely, 102 of 195 countries (52%) did not have any participant samples at CHI (using the list of countries from [60, 61]).

What is the reason for an increase in geographic diversity? Our results showed that CHI participant samples are predominantly recruited from Western countries, but that recent years have seen

Table 4: Top 10 countries of CHI participants between 2016 to 2020. "Participants' countries" shows the total number of participants by country, counting each participant individually. "Countries by ratio" ranks countries by ratio of participant samples, showing their influence on CHI relative to the country's population size. "Countries by $n_{samples}$" ranks countries by the number of samples that report on participants from that country. Countries marked with an asterisk are considered to be non-Western countries that are at or below the median for at least one of the EIRD criteria.

	Participants' countries				Countries by samples ratio				Countries by $n_{samples}$			
Rank	Country	$n_{participants}$	%	ratio ψ_p	Country	$n_{samples}$	%	ratio ψ_s	Country	$n_{samples}$	%	ratio ψ_s
1	USA	136,834	54.84	12.91	St. Lucia*	1	0.09	28.17	USA	493	45.82	7.70
2	Ireland	1,423	0.57	9.00	Finland	18	1.67	16.80	Great Britain	169	15.71	12.88
3	Switzerland	2,152	0.86	7.77	Luxembourg	2	0.19	16.53	Germany	94	8.74	5.80
4	Finland	1,336	0.54	7.53	Denmark	16	1.49	14.29	Canada	82	7.62	11.24
5	Canada	6,367	2.55	5.27	Bhutan*	2	0.19	13.41	China*	64	5.95	0.23
6	New Zealand	768	0.31	4.98	Switzerland	22	2.04	13.15	India*	57	5.30	0.21
7	Bhutan*	92	0.04	3.72	Great Britain	169	15.71	12.88	Australia	53	4.93	10.75
8	Great Britain	7,829	3.14	3.60	Canada	82	7.62	11.24	South Korea	44	4.09	4.44
9	Australia	2,544	1.02	3.12	Sweden	21	1.95	10.76	France	29	2.70	2.30
10	Denmark	577	0.23	3.11	Australia	53	4.93	10.75	Japan	29	2.70	1.19

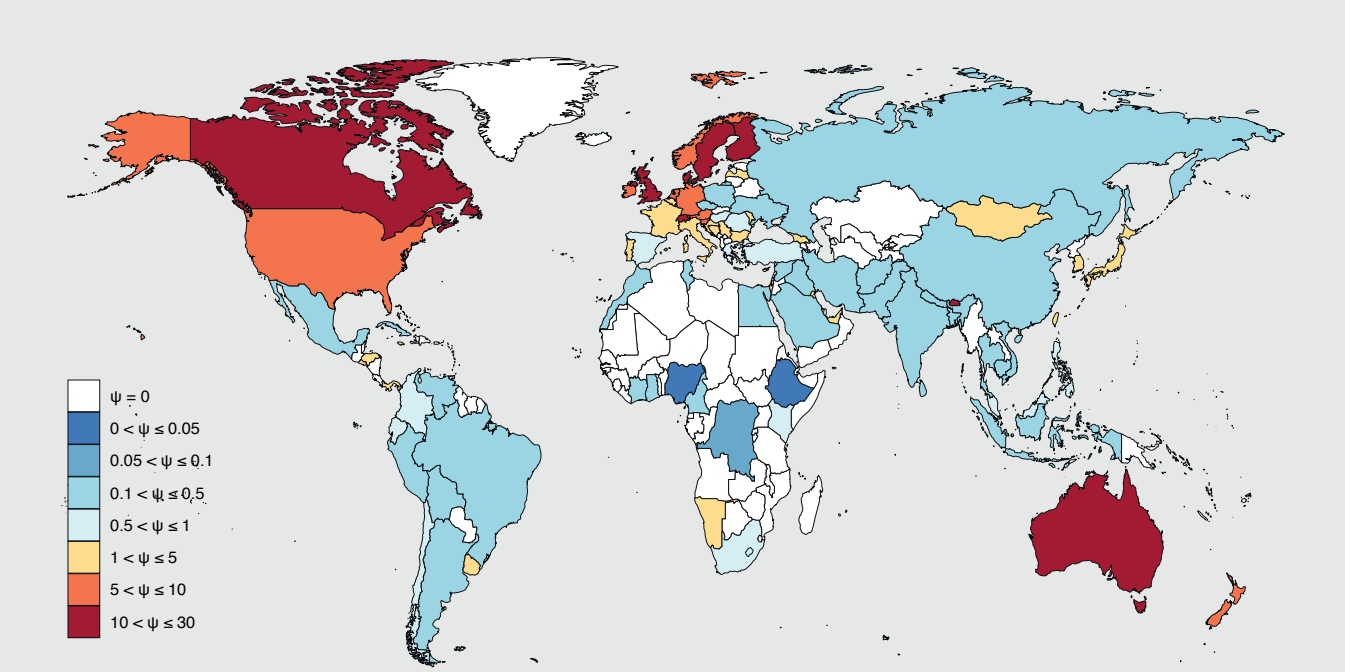

Figure 2: Worldwide distribution of CHI participant samples ratio (ψ_s) between 2016-2020, showing which countries are over-represented ($\psi > 1$) or under-represented ($\psi < 1$), relative to the world's population. Countries in white (N=102) did not have study participants in the past five CHI proceedings.

a slight increase in non-Western samples. We followed up on this result by investigating whether online studies and studies of behavioral logs from online services available in various countries could explain the increase in diverse samples. Per proceeding year, we looked at the methods used in the two papers with the most participants, the two papers with the most diverse samples, and the two papers with the most diverse author affiliations (30 papers in total).

The results of this additional analysis showed that the number of papers that studied participant samples from more than one country has increased in the past years—from an average of 9 papers between 2016-2018 to 29 papers in 2019 and 30 papers in 2020. Most commonly among the top 20 papers with most participants were analyses of behavioral log data, surveys, or (very few) experiments conducted on social networking sites (8/20 papers, e.g., [10, 54]), on other online services, such as on online education platforms (e.g., [24]), or on online game sites (e.g., [54]). Some of the increase in participant diversity can also be attributed to studies that have been conducted on online platforms such as Mechanical Turk (e.g., [6]) or LabintheWild (e.g., [41, 65]).

4.2 Educated

We found a positive correlation between the participant samples ratio ψ_s and the countries' average duration of schooling (r_τ=.46, p<.001) as shown in Figure 3: Most participant samples at CHI come from countries with generally highly educated populations. In comparison to the world population, which has 8.4 years of schooling on average [92], the countries most represented at CHI are heavily skewed towards more years of schooling on average.

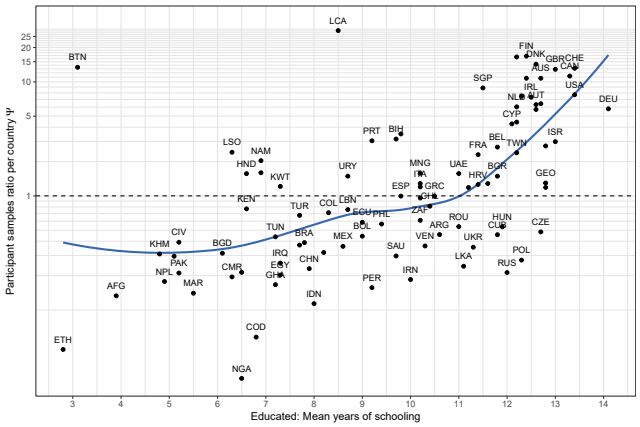

Figure 3: Education: Relationship between the participant samples ratio ψ_s and the mean years of schooling per country. The dotted line indicates the positioning in which a country would be represented proportionally to the country's population. The blue solid line indicates the locally-weighted regression (loess) line. Note the logarithmic scale of the y-axis.

To evaluate the representativeness of education level based on participant samples, we further turned to more detailed descriptions in the papers. Of the 2768 papers with a study, 952 (34.3%) addressed the education of their participants in some way. A slightly lower number of 667 paper (24.1%) provided sufficiently detailed information to convert the data into the ISCED Education levels [88] for comparison. The majority of the participants in these papers (69.93%, n=104,237) were currently enrolled at a university or had completed a university education. 24.45% had higher secondary education, 1.35% had lower secondary education, 0.16% had only primary education and 0.05% had no formal education at all. 1.87% had vocational education and training (dual education). 2.21% of the participants did not provide any information when education level was recorded.

The results demonstrate that around 70% of CHI study participants (in the 24% of papers that described the education level in a way sufficient for comparison) are college-educated and that overall, participant samples are significantly more educated than the average world population.

4.3 Industrialized and Rich

Only 4.55% (n=126) of the studies in our dataset mentioned the income of participants, and the vast majority of these did not mention any numbers and instead characterized their participants as "low income". As such, we are unable to directly establish whether the wealth of participants is representative of a general population.

We instead followed Arnett's approach [3] in using GDP per capita and GNI per capita as proxies for industrialization status and wealth, as described in the methods section. While this approach cannot be used to make inferences about the industrialization status and wealth of specific participant samples, it nevertheless allows us to gauge whether CHI samples may be skewed towards more industrialized and rich countries. Note that while Western countries are frequently industrialized, non-Western countries such as Japan or Korea are in the top 25 of the list of countries' GDP and GNI per capita.

Our results show that CHI participant samples are predominantly from industrialized countries with a high GDP per capita (r_τ = .50, $p < .001$). Seven (7.5%) of participants' countries are among the top 10 largest economies according to their GDP [31]. Likewise, participant samples come from significantly richer countries (M=27,850 Int$) (as measured by the GNI per capita per country) than the average person's wealth (M=17,591 Int$ [32]). This is also supported by the positive correlation between the GNI per capita and the participant sample ratio per country (r_τ=.50, $p < .001$).

4.4 Democratic

CHI's participant samples are predominantly from democratic countries, with a medium correlation between the countries' political rights and the sample ratios (r_τ=.50, p <.001). The correlation can be seen in Figure 4, in which the majority of countries that participant samples came from are clustered on the right side, indicating that they are countries with the greatest degree of freedom in terms of political rights.

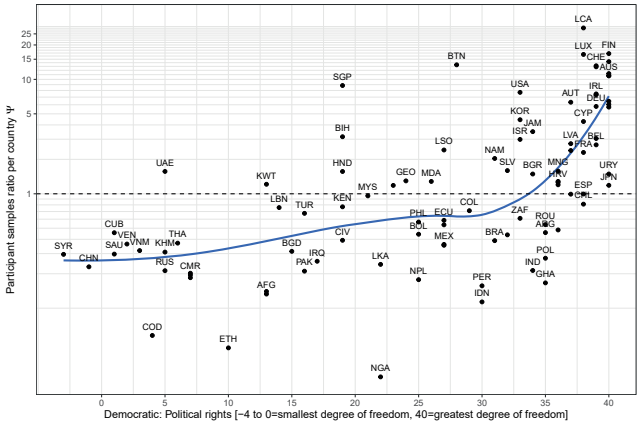

Figure 4: Democratic: Relationship between participant samples ratio ψ_s per country and the average political rights ratings. The dotted line indicates the positioning in which a country would be represented proportionally to the country's population. The blue solid line indicates the locally-weighted regression (loess) line. Note the logarithmic scale of the y-axis.

4.5 To what extent are CHI participant samples from Western, Educated, Industrialized, Rich, AND Democratic countries

While our prior analyses show that most CHI participant samples are WEIRD if focusing on each WEIRD factor individually (i.e., using OR as the logical operator), we were additionally interested in investigating for how many participant samples all characteristics of WEIRD apply (i.e., using AND as the logical operator). We found that 26 countries of 31 Western countries in our dataset are considered WEIRD (if using AND and greater than median for each of the "EIRD" characteristics as a cut off), including all but Bhutan in the list of countries that contributed most participants relative to their population (see left column in Table 4).

Of all 1507 participant samples in our dataset, 1102 (73.13%) were recruited in Western countries and 1070 (71%) were were recruited in countries that considered fully WEIRD, i.e., they are Western AND above the median for educated, industrialized, rich, and democratic. The remaining 405 participant samples (26.87%) were recruited in non-Western countries. Only 85 (5.64%) of these were samples recruited in non-Western but "EIRD" countries (Argentina, Chile, Israel, Japan, and Korea.)

4.6 Sample Diversity in Western Countries and "EIRD" Samples in non-Western Countries

Our dataset and analysis additionally showed that of those papers that use Western samples only a small number studied people of a lower education or income level than the more common (undergraduate student) samples. These papers, such as work by Dillahunt et al. [25, 26], Dombrowski et al. [27], Redmiles et al. [69] as well as Saksono et al. [76] are noteworthy examples of investigations into the diversity of people within Western countries. Hence, while these participant samples are Western, but not strictly "EIRD", they are currently an exception rather than the rule. Of course many non-Western countries, such as South Korea, Japan, Israel, Chile, or Argentina, are often highly educated, industrialized, rich, and/or democratic. Participant samples from these "EIRD-countries" constitute 20.99% of non-Western participant samples (n=85) and 5.64% of all participant samples in the past five years at CHI. These samples can greatly contribute to the international breadth of CHI research and to our understanding of users in diverse (national) cultures.

4.7 Relationship Between Participant Samples and Author Affiliations

To evaluate whether the geographic breadth of participant samples is broader than that of the location of authors (which would shed light on the extent to which authors recruit beyond their local area), we analyzed the author affiliations reported in the 1076 articles that also contained information about participants' countries. Of those, 874 (81.23%) papers studied participants from the same country as at least one of the authors' institutions. In 202 papers (18.77%), at least part of the participant sample was from a country different from the country or countries the authors are affiliated with through their institution. This includes 108 papers (10.0%) that studied participants samples from countries that do not match the country of authors' institutions. Overall, these results demonstrate that a vast majority of authors (over 80%) recruit samples "in their own backyard", or at least in the same country as they are in.

5 DISCUSSION

The primary goal of our work was to quantify the geographic breadth of CHI participant samples. Are participant samples that CHI publications report on representative of the world's population? Our analysis of CHI proceedings between 2016-2020 shows that they are not: 73% of findings are derived from studies with Western participant samples of which 97% come from countries to which all of the five WEIRD variables can be applied. This means that almost 3/4 of the knowledge we produce at CHI is based on 11.8% of the world's population. Moreover, more than half of all countries (102 of 195 countries) did not have any participant samples at CHI in the past five years, suggesting that we know very little about technology users in those countries.

Unsurprisingly, a plurality of CHI's participant samples (45.82%) in the past five years were recruited in the US. While we were unable to derive participants' ethnicity, US samples in the social sciences—most commonly recruited at universities—are likely to be primarily European American [3] and this may be equally the case for most participants in HCI (though it has to be acknowledged that there is a growing movement within HCI to study diverse samples within the geographic US). In addition, while samples recruited at US universities may include international students, they are a minority in these studies and may not be representative of the population in their home country.

On the upside, our findings also, for the first time, showed that CHI participant samples are becoming more geographically diverse. Between 2016 and 2020, the fraction of US samples dropped by around 13 percentage points to 24.84%. During the same time frame, the percentage of non-Western samples almost doubled from 16.31% to 30.24%. While some of this may be explained by the choice of conference location, several other factors seem to have had a positive influence: First, the numbers may be starting to reflect SIGCHI's efforts to diversify the CHI community and authorship, which in turn leads to the recruitment of local samples in non-Western countries. Second, we also found an increase in the number of online studies and studies of behavioral logs, many of which include participants from several different countries. This increase can be attributed to a growing awareness that findings based on one population may not generalize, research efforts that have produced guidelines on conducting online experiments with diverse samples, and to the general big data trend we have seen emerge in recent years. Third, the field of ICTD (or HCI4D) has shed light on technology use in many non-Western countries. Its growth over the past years [22] undoubtedly contributed to the increase in non-Western samples. Similarly, the past years have seen a steady increase in research on non-student samples in Western countries, such as work by Dillahunt et al., Dombrowski et al., Harrington et al. and Vines et al., to name just a few, who studied people with low income or people with limited education (e.g., [25, 27, 34, 95]). All of this research contributes to our understanding of variations in how technology is being used and perceived and we hope that this trend that we have been seeing will continue.

We also aimed to identify which countries are over- and understudied. We found that participant samples from many countries are strongly over-represented at CHI compared to their country's population size, including Finland, Denmark, Switzerland, Great Britain, Canada, Sweden, and Australia. Notable outliers in the list of over-represented countries included St. Lucia (1 sample), Luxembourg and Bhutan (2 samples respectively), all of which have small population sizes. Overall, the list of over-represented countries indicates that CHI's participant samples are often recruited in Western societies that are also more educated, industrialized, rich, and democratic than the majority of the world's countries. Quite strikingly, about 70% of participants were currently enrolled at a university or had completed a university education. This is unrepresentative of the world's population, which only enjoys an average of 8.4 years of schooling [92]. Similarly, CHI participants are significantly wealthier than the average person (GNI per capita: 27,850 Int$ versus 17,591 Int$).

When we examine these results, we might be inclined to compare them to other research fields. Are CHI participant samples more diverse than those in other fields? In 2008, more than 11 years ago, Arnett [3] found that 96% of participants in journals of the American Psychological Association were from Western countries, including the US, Canada, European countries, Australia, and Israel. In 2017, Nielson and colleagues showed that these numbers have changed little, critiquing that psychology research is not "readily embracing change" [62]. The 96% of Western samples in the field of psychology stands in contrast to 73% of Western samples at CHI. In addition, 68% of the participants samples in psychology were in the United States—22% more than the 45.82% of US participant samples we found in the CHI proceedings. These numbers suggest that CHI samples are more representative than those in psychology. The result is plausible, given that participant recruitment in psychology is still largely dependent on student participant pools and study credits, which are not as commonly used by HCI researchers. However, Arnett also found that the 96% of psychological samples only represented 12% of the world's population, which is exactly the same percentage of the world population that we found represented in the past five CHI proceedings. Hence, while CHI researchers recruit subjects from more countries than psychology, they are repeatedly recruiting from countries that are already over-represented. Focusing on growing CHI in countries that are currently under-represented would therefore improve the representation of the world's population, at least geographically.

Overall, our findings show that CHI researchers are still most commonly—in at least 73% of all cases— studying participants who have been shown to differ from the average person in their behaviors, preferences, analytic reasoning, and in their degrees of fairness or cooperation [36], inhibiting external validity and a broader understanding of how people use technology. Indeed, HCI studies comparing countries and cultures in recent years have started painting a picture of the diversity of technology users, showing differences ranging from security and privacy behavior [77], perceptions of emoji [47], to visual preferences for websites [70] and social comparison [7]. Many of these studies have concluded that one size may not fit all and that we should be increasing efforts to understand technology use in other countries and cultures [47, 70, 77]. To do so, it will be essential to continue efforts by the CHI community to increase studies of participant samples in other countries. In the next section, we discuss ideas for further diversifying who we study and how.

6 IDEAS FOR MAKING CHI LESS WEIRD

Readers may now ask themselves: Should all CHI researchers study geographically diverse samples? We believe this is neither possible nor desirable. In fact, there is immense value in focused studies that investigate specific groups of people in specific countries and contexts, such as commonly done by ICTD researchers [22] or by HCI researchers focusing on populations with certain ethnicities, income levels, education levels, or other identities (e.g., [25, 27]). This includes studies with very common participant samples, such as American undergraduates. All of these studies have in the past contributed insights that formed the technology we use today. However, we do think that the CHI community needs to amplify its efforts to study non-WEIRD participant samples and to clearly communicate their samples' identities and potential implications for generalizability.

Improving the representation of non-WEIRD participants, however, is a complex undertaking and raises concerns of power, as suggested in Irani and colleagues' work on Postcolonial Computing [43]. A well thought-through solution should not only focus on increasing the number of non-WEIRD participants, but also on increasing the diversity of researchers and of those who are commissioning and funding the research (i.e., companies and funding agencies). Considering different stakeholders will lead to an increase in the diversity of viewpoints, research needs, and interpretations of research and results.

Based on our results, we compiled a list of possible ideas to address the fact that CHI research skews Western. It must be mentioned that this paper was written by authors who work and live in three countries that all meet the WEIRD criteria. While many of us have years of experience in intercultural contexts in business and science, this background influences our view of potential solutions that may address the WEIRD problem. We hope that these ideas are seen as a starting point to more comprehensive discussions among the global CHI community.

Diversifying authorship: Our results demonstrated that 81.23% of CHI papers in the past five years reported on locally recruited samples, suggesting that a key opportunity to achieve a greater sample diversity is to grow the geographic breadth of authors across the world. Balancing the number of CHI authors and co-authors from non-WEIRD and WEIRD countries will have various positive effects, from diversifying viewpoints and counteracting confirmation bias to facilitating the recruitment of non-WEIRD participant samples and enhancing the discussion of CHI findings and research emphases. The most direct way to achieve an increase in non-Western authorship is to increase the number of papers authored by non-Western authors. In addition, the CHI community could also increase efforts to foster collaborations across Western and non-Western countries. However, it is crucial that such collaborations result in mutually beneficial collaborations. In particular, diversifying authorship should never be a means to an end; instead, the focus should be on achieving a shared research goal and promoting mutual support and benefit. Given the current academic system

of recognizing research contributions, it is particularly important that none of the important work goes unnoticed (see for instance [38] for a more in-depth discussion on crediting contributions to scientific scholarly output).

Potential avenues for diversifying authorship have already been ongoing (e.g., SIGCHI's initiatives [59]). These efforts could be continued and extended by nurturing interactions and collaborations among researchers across countries, such as by (virtually) co-locating the CHI conference with SIGCHI In-Cooperation conferences (e.g., with Asian CHI [83], IndiaHCI [35], or CHIuXiD [17] in Indonesia and South-East Asia), by developing workshops that get together researchers from various countries and regions, or by continuing efforts like the open and scalable university laboratories as was done by Vaish et al. [93]. In addition, it will be important to reduce barriers to publishing and attending CHI, such as by more frequently seeking conference locations in non-Western countries, which our data suggests may increase the number of submissions that include non-Western participant samples. In line with this, many other approaches would need to be combined: from lowering registration fees and/or enabling virtual attendance, growing the reviewer pool to include more diverse viewpoints for evaluating submission, all the way to ensuring that potential language barriers do not skew paper acceptances towards English-speaking countries. None of these approaches are straightforward to achieve given budget and other constraints, but little steps towards some of these may already go a long way.

Fostering the use of online research: While local recruitment of diverse participants remains a bottleneck for studying representative samples, studying online samples can sometimes help [8]. As we found in our analysis of papers that study participants from more than one country, they usually reported on studies of behavioral log data and large-scale surveys and experiments. Research that is amenable to the recruitment of online participants could be more often conducted online, preferably by authors from various countries and cultures to promote research diversity and offer various perspectives.

To support researchers in conducting such online studies, HCI research should add to existing efforts that have investigated how online research can preserve data quality and allow a wider variety of experiment methodologies (e.g., [8, 66–68, 71], including qualitative studies. In addition, HCI research has already contributed novel crowdsourcing platforms [30] and volunteer-based experiment platforms [45, 71] that mitigate some of the concerns about Mechanical Turk [67]; these efforts should be continued and ideally be made available to all of HCI. Moving all research online is of course neither possible nor desirable; in fact, online research excludes large parts of the world population who are without Internet access (an estimated 49% [90]), who do not access specific platforms and services, or who are not reached by online recruitment messages. Nevertheless, we believe that online research could be increased and that this could add to our understanding of people's technology use in other countries and cultures.

While this may sound straightforward, it is not going to be a solution to solely support Westerners in doing more research with non-WEIRD participants. In fact, such a scenario could easily aggravate imbalances, for example if Western companies benefit from this research by increasing sales in non-Western markets. As mentioned above, any efforts to increase the use of online research have to go hand in hand with other advances to improve the diversity of CHI authorship, tech leadership, and funding sources. Specifically, these efforts should be focused on supporting researchers in conducting online studies in non-Western countries as much as in Western countries to ensure that we can deepen our understanding of HCI using various points of view.

Developing methods for studying geographically diverse samples: Another way to increase geographically diverse participant samples is by supporting Western and non-Western researchers in conducting studies with participants in countries other than their own by developing appropriate methods and case studies. For example, prior research has shown a five times increase in response bias if interviewers are foreign researchers requiring a translator, and offered guidelines for reducing this bias [23]. Researchers have also developed methods for eliciting values in non-Western societies [2], and for adapting the think-aloud method to other cultures [18]. Irani et al. [43] proposed a reframing of methods to see participants as "active participants and partners" rather than a passive knowledge resource. In short, the CHI community has a breadth of knowledge about conducting research across countries and cultures, large-scale research with diverse samples, and qualitative studies in local communities. However, it is rare that we share the experiences and knowledge gained when designing, recruiting for, and conducting these studies, including what may have gone wrong. Encouraging CHI papers, experience reports, and workshops on these topics would provide a go-to-guide for authors who are interested in studying small and foreign or large and diverse samples and lower the barrier to entry to researching non-local, diverse samples.

Appreciating replications and extensions of findings: CHI has seen various discussions around the replication of research (see, e.g., [73]), which can ensure that findings are stable, despite differences in the makeup of participant samples or over time. RepliCHI [99], for example, is a series of workshops at CHI that has called for discussions around revisiting work for purposes of validation. But replications can also uncover variations in the findings that may be due to demographic, geographic, and/or cultural differences between samples included in the original and replication study. Such replications and extensions of studies should continue and be promoted, including efforts to raise awareness among authors and reviewers about the value of attempting replication and extension of prior results in other countries, in a variety of contexts, and with a variety of participants.

Report and track the international breadth of participant samples: One surprising finding in our study of CHI papers was that 5.7% of the CHI papers in the past five years did not mention any participant numbers. A little more than 56% did not mention participants' country affiliation, nor could it be inferred from the author information. While reporting on participants' countries in detail may not be realistic for studies with geographically diverse samples, including country information should become standard for most CHI papers to facilitate replications, extensions, meta analyses, and to track the international breadth of participant samples in the future. Fostering the inclusion of geographic information in CHI papers most likely requires better guidelines for reporting on the number of participants and their demographic information,

such as age, gender, education level, and country of origin. These guidelines should already be incorporated in the paper templates and in structured ways during submission, providing authors with best-practice examples of how to report on participants. Similar to the recommendations Schlesinger et al. [78] made by suggesting to "consistently report context" and "consistently report demographics" in research papers, we also believe that better guidelines and standards for reporting this information will be essential for facilitating automated analyses and better tracking of the geographic breadth of participant samples in the future. Being able to automatically extract participant demographics from the papers and/or meta data provided by the authors would not only facilitate automatic analysis, but also meta studies and comparisons between studies.

Identification of constraints on generalizability: The fact that most CHI papers study Western samples in itself is not necessarily bad; it is only questionable in cases where findings may not generalize, but are presented that way. Similar to our suggestion above, it may be helpful if papers detailed on the sample composition, how it compares to the world population, and whether this may impact generalizability of results. One way to ensure that papers adequately describe samples, address potential question of generalizability, and suggest future work to replicate or extend the study with a different sample, is by having a geographically diverse set of reviewers. These reviewers could be encouraged to not only describe the contribution of a paper as is already standard, but to also pay attention to the representativeness of samples and generalizability across countries and culture. Non-Western reviewers, in particular, may be more sensitive to findings that may not generalize, and may be able to suggest alternative interpretations in their reviews. Ideally, CHI should encourage at least one non-Western reviewer per paper and include recommendations on what to look for in the PCS review form.

While far from complete, we hope that these initial ideas can serve as a starting point for further ideation and brainstorming among the CHI community for how to increase the diversity at CHI.

7 LIMITATIONS AND FUTURE WORK

Our work has focused on the WEIRD framework and the geographic distribution of study participants. However, nationality, education, level of industrialization, economic power and the political context are only a very small subset of factors that might influence findings in HCI. This means that our work does not generalize beyond the WEIRD framework and the results should not be used to infer the diversity of CHI participant samples in general.

Our results also do not allow inferences about individuals' demographics and identity because papers in the CHI proceedings rarely provided detailed information, such as on a participant's country of origin, their cultural norms, or personal education and income level.

A limitation of our ideas for diversifying CHI participant samples is that this paper was written by authors from countries that all meet the WEIRD criteria. As mentioned in the Discussion section, this has undoubtedly influenced our view of potential approaches that may address the WEIRD problem. An important next step will therefore be to discuss and broaden these ideas with the global CHI community.

In future work, it would also be interesting to compare our work to related conference venues and journals, such as CSCW [19] or ToCHI [85] and to more systematically test which changes to these conferences lead to a geographic broadening of participant samples. We also hope that our work will spark an interest in tracking WEIRD metrics over time, as discussed above.

We are also excited about future efforts that focus on within-country representation of authors and participants. We envision such future work to rethink using the political world map as a major reference to group study participants. Instead, researchers could develop ways to quantify the impact of all diverse factors on human interaction with computers, which would necessitate regrouping people based on individual characteristics which they share across national borders, such as gender, personality, education, religion, class and experience with technology.

8 CONCLUSION

Our goal with this work was to quantify the geographic breadth at the premier conference for Human-Computer Interaction, CHI. We presented an empirical analysis of the international representativeness of participant samples between 2016 and 2020, showing that at least 73% of CHI study findings are based on Western participants, representing less than 12% of the world's population. Our findings revealed that participant samples are more educated, industrialized, rich, and democratic than the average population, demonstrating that CHI is largely a conference of WEIRD participant samples. Encouragingly, our analysis also found that the number of non-Western samples has increased in recent years, and that several studies conducted in Western countries included less commonly recruited participants, such as low-income or non-college educated populations. This suggests that CHI efforts on diversity may be starting to bear fruit. Based on these results, we provided actionable suggestions on diversifying CHI authorship, facilitating recruitment of non-Western samples, and tracking geographic representation of study participants in the future. We hope that our findings lead to further discussions around diversity and inclusion in the CHI community.

9 DATASET

Our dataset including all annotated articles from the 2016-2020 CHI proceedings can be found in the supplementary materials.

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WEB PAPER

Mobile learning in resource-constrained environments: A case study of medical education

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Abstract

Background: The achievement of the millennium development goals may be facilitated by the use of information and communication technology in medical and health education.

Aims: This study intended to explore the use and impact of educational technology in medical education in resource-constrained environments.

Methods: A multiple case study was conducted in two Nepalese teaching hospitals. The data were analysed using activity theory as an analytical basis.

Results: There was little evidence for formal e-learning, but the findings indicate that students and residents adopted mobile technologies, such as mobile phones and small laptops, as cultural tools for surprisingly rich 'informal' learning in a very short time. These tools allowed learners to enhance (a) situated learning, by immediately connecting virtual information sources to their situated experiences; (b) cross-contextual learning by documenting situated experiences in the form of images and videos and re-using the material for later reflection and discussion and (c) engagement with educational content in social network communities.

Conclusion: By placing the students and residents at the centre of the new learning activities, this development has begun to affect the overall educational system. Leveraging these tools is closely linked to the development of broad media literacy, including awareness of ethical and privacy issues.

Introduction

The potential and role of technology-enhanced learning for under and postgraduate medical education has been thoroughly explored in Western countries, which consider it an equally effective and useful supplement to traditional methods (Wutoh et al. 2004; Harden 2006; Cook et al. 2008). Much attention is paid to the role of mobile learning for educating medical students and health professionals (Sandars et al. 2007; Coulby et al. 2009; Irby 2011). In 'developing countries', even greater expectations are attached to information and communication technology (ICT), particularly with respect to education and health (Chandrasekhar and Ghosh 2001; The World Bank 2011). The latter has a pivotal role in the context of the UN millennium development goals, where three out of eight goals are directly related to health (UN Website 2010). Inadequately skilled health staff is seen as a typical system constraint that negatively impacts the achievement of these targets (Travis et al. 2004). Technology plays a crucial role in improving the education and practice of health workers in developing countries (Pakenham-Walsh et al. 1997). In these contexts, ICTs can enable students and professionals to access up-to-date information and learning materials (Katikireddi 2004; Jadoon et al. 2011), and these individuals may, in turn, reach a much larger group of 'final beneficiaries' (Chandrasekhar & Ghosh 2001). Currently, the evidence appears to suggest potential rather than achievement. In fact, the use of information technology in developing countries seems to be poorly integrated within formal learning curricula (Kommalage & Gunawardena 2008). Attempts to harness ICT are troubled by a number of factors, such as a lack of media literacy (Ajuwon 2003; Samuel et al. 2004; Khalid 2009) and the lack of an adequate ICT infrastructure (Chandrasekhar and

Practice points

- Medical students in the setting of a developing country rapidly adopt mobile internet technology for rich educational practices
- Technologies support (a) situated and (b) cross-contextual learning and (c) educational engagement on social network sites in professional communities
- Technology is predominantly used in 'informal' higher education
- By placing the learners at the centre of the new mobile technology mediated activities, this development has begun to affect the overall educational system.

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Ghosh 2001; Kommalage and Gunawardena 2008; Williams et al. 2010). Little is known about how learners can effectively use technology to support their learning in 'resource-limited' settings and how this affects medical education in developing countries.

Material and methods

Theoretical approach and research question

Cultural–historical activity theory allows the analysis of changing systems and the learning associated with them. Accordingly, this approach can be considered appropriate for addressing the questions indicated above. In the field of education, this theory is, inter alia, widely used in studies on technology-enhanced learning and ICT use (Nardi 1996a; Kuutti 1995; Jonassen & Rohrer-Murphy 1999; Isssroff and Scanlon 2002; Sharples et al. 2007; Blin and Munro 2008) and has been applied in medical education (Varpio et al. 2008; Wearn et al. 2008; Brown 2010). The central construct of the theory is an 'activity' that involves subjects (e.g. medical students) who engage in actions by using tools (e.g. a stethoscope) to achieve specific objectives (e.g. provide good patient care) (Leont'ev 1974). Individuals do not act in isolation; they are members of one or more communities (e.g. clinical teams) that are organised by a particular division of labour (e.g. what is done by the student), and their actions are shaped by explicit and tacit rules (e.g. when it is appropriate to use a stethoscope) (Engeström 1987; Engeström 2001; Varpio et al. 2008) (Figure 1).

Activity systems (AS) are open and unstable systems in which contradictions (i.e. historically accumulating structural tensions) are sources of conflict that also result in innovative changes in activities and learning. Contradictions can be caused by the adoption of an external element (e.g. a new technology) that collides with existing elements, such as rules and divisions of labour (Engeström 2001). In view of this theoretical basis and in an attempt to address gaps in the literature, we have identified the following research questions:

- RQ1: To what extent does the adoption of tools (in the form of new ICT) lead to new and adapted learning activities of undergraduate students and residents in resource-constrained environments?
- RQ2: To what extent does the adoption of tools (in the form of new ICT) lead to contradictions and changes of rules, communities and division of labour in the respective activity systems?

Setting, sampling, and data collection

This study was part of a larger research project exploring the role of ICT in the context of medical education in developing countries. The example of Nepalese medical education was used as a case environment with Hindu and Buddhist roots in one of the world's poorest countries (Human Development Report 2011). Two researchers interviewed a purposive sample (Patton 2002) of students, postgraduates, teachers and faculty members from a public and a private university to account for varying perspectives based on age, role and socio-economic and organisational background. Focus groups were chosen as a primary method because they are effective in capturing changes in the context of medical education (Barbour 2005). In April 2011, after consent was obtained from the institutions, we presented the research process and goals to interested students and teachers at each university and invited them to participate in focus groups. We subsequently conducted eight focus groups of four to eight participants each ($n = 43$), lasting from 57 to 93 minutes (Table 1). Anonymity and confidentiality were ensured. All participants agreed to be interviewed before the discussion, and all of them allowed the conversations to be audio-taped. The semi-structured

Table 1. Description of sample characteristics.

No	Institution	Degree
01	University A	Undergraduate students
02		Undergraduate students
03		Postgraduate students
04	University B	Undergraduate students
05		Undergraduate students
06		Postgraduate students
07	University A and University B	Teachers/faculty
08	University A and University B	Teachers/faculty

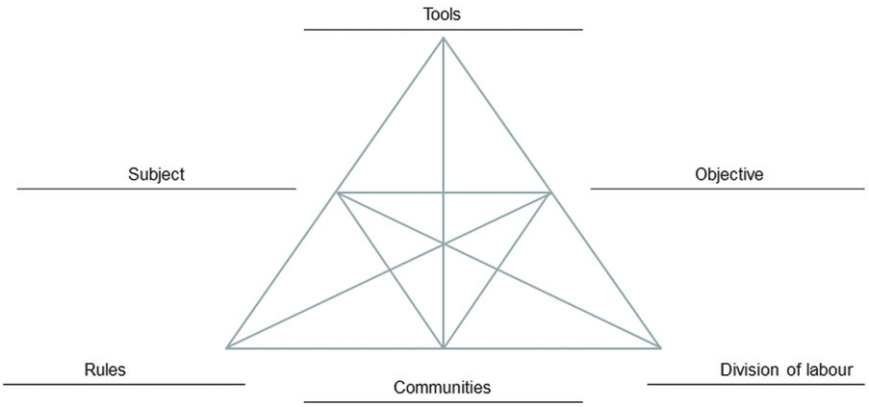

Figure 1. Depiction of an activity system. Adapted from Engeström (1987).

interview guide focused on the use of ICT by undergraduate and postgraduate students for medical learning, working and leisure time use and, more generally, on medical education in the respective cultural contexts. The guide was constructed based on preliminary, Skype-based one-on-one interviews with four students from each university held five months prior to the on-site visit. The discussion of themes that emerged during the focus groups was explicitly encouraged. The focus groups were conducted in English, the working language in Nepalese medical education. The researchers CP and SL alternated as interviewers and observers, making notes during the interviews and site observations.

Data analysis

The interviews were audio-recorded, transcribed verbatim and entered with the field notes into the qualitative data analysis software *NVivo8* (Lewins & Silver 2009). Data analysis was guided by deductive principles of qualitative content analysis (Mayring 2004). Taking the adoption of new ICT tools in the form of new and emerging 'activities' as a starting point, the other affected elements and the resulting tensions, contradictions and changes in the AS were used as an analytical basis. Two of the researchers, CP and SL, jointly coded 75% of the interviews. The rest of the material was coded by CP. The findings were discussed with all authors until consensus was reached. These discussions and the member checking, in which all participants were invited to comment on the findings (Giacomini & Cook 2000), were integrated into the final version of the study.

Ethics

Because no formal framework was available for ethical approval, consideration of ethical issues was provided by an expert outside of the research group who was part of a Swiss ethical review board. In his expert opinion, our work did not contravene the Declaration of Helsinki. However, he identified issues related to *Ethical Legal and Social Issues* (ELSI), such as quotations in which participants reported documenting and re-using patient-related data through private technologies. The expert emphasised that anonymity must be ensured so that no plausible harm to the interviewed groups/participants could arise from the study. He suggested concrete measures to make it impossible even for persons involved in the research project (other than the interviewers) to link any statement to specific individuals or groups. Accordingly, information such as the organisation, group size and dates of the focus groups, which was originally included, was removed from Table 1.

Results

Due to the similarity in the Activity Systems (AS) of undergraduate and postgraduate students (both groups take exams and work in patient care), we summarise the results of the two systems in the following section. Variations that result from the stronger focus of postgraduates on patient care will be explicitly indicated.

RQ1: New and adapted tool-mediated activities

In this section, we address the question to what extent the adoption of tools, in the form of new ICT, led to new and adapted learning activities of undergraduate students and residents in resource-constrained environments. In the settings we observed, we found little evidence for systematic and 'formal' forms of e-learning and e-teaching, except for the use of electronic presentation slides in the classroom. The analysis yielded, however, three new and emergent learning activities that were based on the rapid adoption of mobile devices, in the form of mobile phones and small laptops, within a time frame of only three to five years; activities that will be reported in the following three sections. In general, ownership and use of mobile phones and internet was reported to be a very broad and frequent phenomenon:

> Interviewer: Are there many mobile [phone] users?
> Interviewee: Everyone has a mobile.
> Interviewer: Do they use it for the internet as well?
> Interviewee: Yes. Almost everyone is using it.
> (Focus group 01, the number is cross-referenced with table 1)

Search for ad-hoc information. All students, particularly undergraduates, intensively used their mobile devices to spontaneously search for information. They reported that they tended to look up information *ad-hoc*, mostly using Google, when they encountered situations in which they did not understand terms or concepts. The interviewees reported accessing information *in situ* as needed in hospitals to understand a particular case or when they were studying for exams and were unable to find relevant information in their textbooks. In this sense, mobile devices supported learning and sense-making that arose within the immediacy of a situation by linking codified knowledge to situated cognition.

> I went to the hospital and there was one lady who was diagnosed with [. . .] and I didn't know what it was. So I looked it up what it was and there was a nice picture. (02)
> If we are confused we just take it [mobile phone] and look on the internet. [. . .] we are in the hospital, walking around. (02)
> I use it during my postings when I want to look into a topic when I don't have access to books. When I am in the OP for example I don't have the book so I go to the mobile. And other times when I'm in the library and read the book but need a picture of a certain topic so I look for the topic. (01)

A few years ago, the only information sources available to students consisted of a limited number of books and teachers. At the time of this study, students reported accessing a variety of additional, current, in-depth sources in a more immediate and 'situated' way, which they deemed central to their learning.

Documentation and sharing of images and videos. In clinical environments, many of the undergraduates used their

mobiles to take photographs and record videos of special cases, procedures or instruments, such as in the operating theatre or in the dissection room.

> The teacher would show an instrument and we will be asked about this in the exam so we will take a picture. (04)
> [I take pictures] for cases that are difficult to see that's for future purpose and learning purpose. (04)

This method allowed students to capture their situated experiences in the hospital or lecture halls and carry them to other learning contexts. They re-used the multimedia materials at later points in time for personal study purposes, to prepare for their exams, or to share and discuss their experiences with colleagues in other social and physical contexts.

> 'If we have a photo everyone copies.' (01). All of us share it to one another. (06)
> Because I can see the same case again and again [. . .] I will see that again and again. (04)

While both postgraduate and undergraduate students shared these materials with their colleagues in informal contexts, postgraduates also integrated them into their regular presentations to faculty.

Educational engagement in social network sites. An intriguing finding was the crucial role of the social networking portal Facebook in the life of nearly all interviewed students. Students most often accessed Facebook by means of their mobile phones and used it for both entertainment and other non-academic purposes. However, a reasonable number of students, residents and even some teachers in all of the focus groups also indicated using Facebook for educational purposes, mostly by means of specific sites about medical and clinical topics. These sites were used by a large number of international users, particularly from developing countries.

> 'Medical profession, I love it.' That's a [Facebook] group. I'm part of the group.[. . .] He [the group convenor] asks questions to medical students and gives the correct answers. [. . .] there are more than 15000 people. (03)

By participating in these communities, students engaged in different forms of learning and interacting, including discussions of multiple- and single-choice questions and multimedia-enhanced cases. Students indicated that these 'pictures and questions' (03) were relevant to their learning.

> It's very beneficial. We can know many things from it. [. . .] There are so many things we don't know from the textbooks. [. . .] Even some simple things. While reading Facebook, it's important and you need to remember it. (05)
> I get used to the clinical questions and some points to learn. When I miss something in my studies we get that point as well. (05)

RQ2: Changes of rules, communities, and division of labour

In the following sections, we address the research question how the adoption of tools (in the form of new ICT) led to contradictions and changes of (a) rules/regulations, (b) communities and (c) division of labour in the respective activity systems.

Altered rules, regulations, and cultural norms. The data support the view that the adoption of new ICT tools has led to aggravated tensions and contradictions, as well as conflicts with existing elements, such as rules or regulations. This holds true, for example, among students who were criticised by their teachers for their 'copy and paste mentality' and for their non-reflective and uncritical use of internet content.

> They don't read the textbooks; they search the internet instead. [. . .]. They don't know the basics [. . .]. Sometimes erroneous things are given. It's not like the textbooks or authentic journals. We tell them not to totally rely on the internet but to first read the textbooks. (07)
> They are not using their brain. [. . .] They just copy paste. They don't know the meaning. (08)

Tensions were also evident in the form of activities that students attempted to hide and did not perform in front of their teachers:

> We do it in front of the patients but not in front of the teachers [. . .]. Most of the teachers don't like using mobiles. [. . .] It's not a rule but they don't like it. (05)

In one of the institutions observed, access to social network sites and other 'non-educational sites' was banned during lecture time. These kinds of tensions also resulted in rules that changed over time. For example, undergraduates reported that the use of mobile devices was completely banned in their classes: 'We weren't allowed in our times [. . .] to take pictures or videos' (05). However, students in the following year of the same focus group indicated that they used their mobiles in all subjects to document relevant artefacts after class: 'While teaching, we are not allowed, but after the class, we can go and take pictures' (05).

Changes and extension of communities. The adoption of ICT has led to changing practices within existing communities, such as when students communicated with their peers on social networking sites and extended their offline communities, or when they shared images and videos via their mobiles in ways that were not previously possible. The students explained, for example, how they exchanged multimedia materials in their communities and stressed the importance of these materials for themselves and their friends.

> [We show the picture] to flat mates. 'This is the case I have seen.' [. . .] The whole batch gets it. [. . .] We proudly show it to the others. (04)

ICT, in general, and Facebook sites, in particular, also allowed the learners to access new social communities, beyond local borders, that were not linked to existing offline communities.

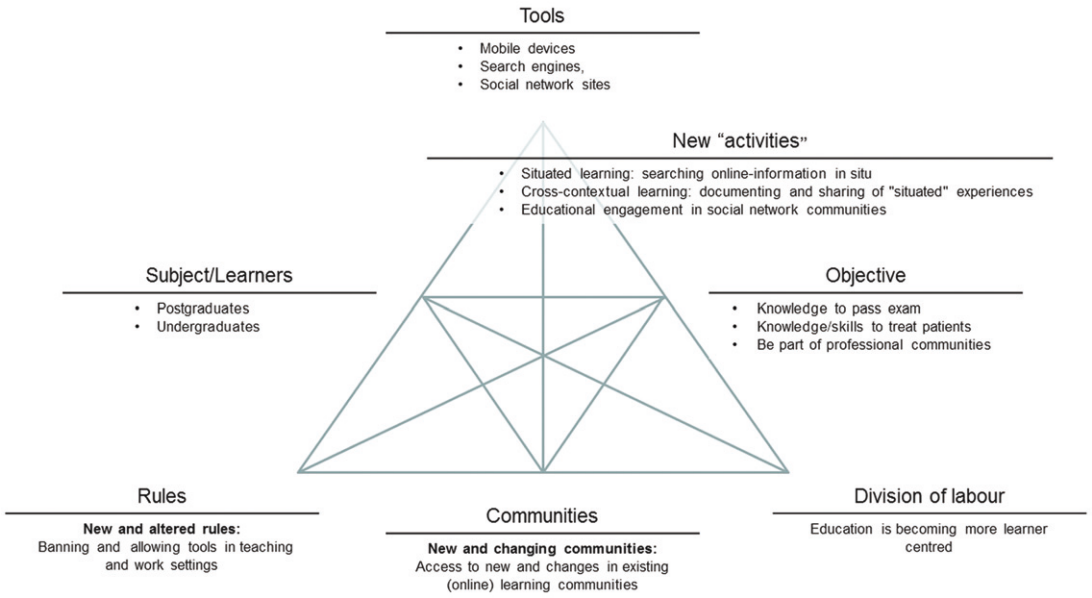

Figure 2. AS regarding the adoption of ICT as tools for learning in medical education in developing countries.

Some of the participants indicated that they participated in international medical groups, and some of them reported using Facebook to prepare themselves for postgraduate career opportunities abroad.

Division of labour: Towards learner-centeredness. Contradictions in the AS have also resulted in an 'altered division of labour'. Although teacher-oriented education (still) characterised formal educational contexts, the learners were at the centre of the new and emerging activities. In contrast to the previously mentioned statements made by teachers about students' uncritical and non-reflective use of ICT, the teachers also acknowledged positive changes with respect to the 'division of labour', as indicated in the following statement by a teacher:

> There has been a dramatic change. We don't have to teach everything now. It's not teacher based learning. It is student based learning. We just tell them and guide them. We give them topics. We tell them to look up and search those topics on the internet and we ask them to verify them from the textbooks. If they find something new and interesting they can ask us. The students are helping us. They are stimulating us to study more. It's a two-way conversation. And the students are also contributing. (08)

Changes were not restricted to one or more communities within an AS; they also played out across different systems and altered the distribution of knowledge between students, residents and teachers. For example, transformations in the AS of undergraduates impacted the 'knowledge gap' between postgraduate and undergraduate students.

> These days internet is available and even bachelor students are interested. They come with the latest information even before us. (03)

The use of internet technologies by postgraduates, in turn, has affected the behaviour (or activities in the AS) of teachers and faculty members, as illustrated in the following statement:

> So it [the teaching] is more based on our own experience and the textbooks that we follow. But the postgraduates have been used to the internet research from the start. The teachers have to follow the same way. There's no way out. (07)

Mobile phone-based internet access was in particular crucial for students. While teachers and faculty also used their mobiles, they preferred to access the internet by means of their laptops (Figure 2).

Discussion

Situated, cross-contextual learning, and educational engagement on social network sites in informal learning contexts

The fact that we found hardly any evidence for 'formal' e-learning in the case context is not atypical for (medical) education in developing countries, where the use of such educational practices is troubled by inadequate infrastructure and a lack of media literacy. In this light, it was even more surprising to observe to what extent, at what scale and how quickly learners have adopted electronic mobile devices, such as mobile phones and small laptops, as new cultural tools, and how they have appropriated these devices for educational purposes in informal learning contexts. The research yielded three tool-mediated 'activities' (or, as we would prefer, 'practices') that enhanced students' situated and cross-contextual learning and professional participation in ways that were not previously possible.

By using mobiles to search for *ad-hoc* information, students supported the 'situated' learning experiences that arose within

the immediacy of a given situation, such as during the treatment of patients. In this sense, mobile devices facilitated interaction and sense-making between individuals and their environments in the '*flux of on-going activities*' (Nardi 1996b). These tools encouraged the students' learning not only in, but also beyond and across individual situations. The ability to capture audio and video materials enabled learners to document and share their 'situated' experiences and enhanced their learning 'across multiple contexts' (Sharples et al. 2007), such as lecture halls, hospitals, hostels and homes. In this sense, the tools supported the learners in accumulating (learning) experiences and knowledge across activities, places and times and within and across contexts marked by fluidity, instability and fragmentation (Pachler 2009), which are typical characteristics of medical and clinical education. However, tool-mediated learning and sharing of experiences were not restricted to local contexts. Facebook, which was mostly accessed by means of mobile devices, allowed students to participate in professional communities that ranged far beyond regional borders. Students engaged with educational content within a community of practitioners that included medical students and professionals across developing countries.

Transformation arising from informal, learner-centred contexts

Notably, learners are at the centre of the new and emerging activities. The identified tool-mediated activities were most frequently applied in personal, informal learning contexts. These activities also affected formal learning environments through, for example, the documentation of multimedia material in lecture halls. Similarly, we have shown that transformation spread beyond single AS to mutually influence the AS of students, residents, teachers and faculty. This is consistent with studies from other areas that have reported how students and postgraduates stimulated the learning of medical teachers (Balmer et al. 2008) and caused changes in clinical cultures (Bleakley 2002). In this sense, the adoption of new tools increased the agency of the learners – 'the capacity to deal with, and to impact on socio-cultural structures and established cultural practices' (Pachler et al. 2010a). This is all the more remarkable because in the Nepalese culture teachers have a central role and students rank them much higher in the social hierarchy; for example, they 'have been «trained» not to ask questions' (Lemone 2005). Similarly, these findings underline that formal learning environments, such as lecture halls and teachers, are 'no longer the gatekeepers of knowledge and the personal expertise' (Pachler et al. 2010b).

Practical considerations

We have shown how medical students in a developing country adopted mobile (internet) technologies for educational purposes in informal learning contexts in the context medical education. This engagement does not necessarily lead to better ways of learning, but it raises a number of questions in relation to what Varpio et al. (2008) called 'varying levels of competence with each tool' for AS or what might be considered a broad notion of media literacy, including the access, analysis, evaluation and creation of messages (Livingstone 2004). Ethical aspects and issues of privacy must be considered when learners share clinical experiences through social network sites or when they create content by recording images and videos in clinical settings. Such issues are by no means limited to developing countries but are also prevalent in 'Western' nations (Wishart 2009; MacDonald et al. 2010). Taking clinical images with cameras and mobile phones for learning and teaching is considered a non-therapeutic function of clinical photography and is not directly relevant for the patient's health (Berle 2008). Accordingly, students and medical professionals should be encouraged to obtain explicit, written consent for unidentifiable images (Bhangoo et al. 2005). In view of this widespread and frequent phenomenon, it has been recently called for the integration of a code of ethics for clinical photography in codes of practice. These codes should include methods of acquisition, storage and retrieval and should also take issues of both copyright and the use of (private) mobile phones and video cameras into account (Berle 2008). When using information from social network sites or from the internet in general, learners should be sensitised to the evaluation of trustworthiness as well as to a critical appraisal of messages (rather than a 'copy and paste' mentality). Similarly, students must be supported in their purposeful use of such resources to facilitate their learning rather than becoming distracted. This challenge is not restricted to the contexts observed in this study (Bugeja 2006). We suggest that the new 'activities' should not be ignored or restricted in formal educational settings (as in the evidence in our case study). As emphasised by Pachler et al. (2010b), these activities must be systematically addressed, acknowledged, and aligned with formal educational contexts. As noted by Cole and Engeström, these questions must be addressed before new and emerging activities are transformed into institutionalised cultural practices with 'radically Ionger half-lives' (Cole & Engeström 1993). Such issues should not be addressed at the level of individual teachers; they must be part of the medical curricula at institutional and national levels.

Limitations and further research

Although we have been unable to discuss new and emerging tool-mediated practices in great detail, we were able to identify and critically discuss pivotal developments and aspects of their systemic implications in the context of medical education in developing countries. We invited interested students to participate in the focus groups. This sampling strategy might have led to bias in the data. Our research was also limited by a single period of data collection and a focus on a single cultural setting. However, there are indications in the literature that ICT supports the transformation of health systems in other geographic and cultural areas (Abdul et al. 2011). Cultural historical activity theory has served as an appropriate starting point for the focus of this analysis, but a much wider range of theoretical concepts is necessary to explain the phenomena at hand. Accordingly, we propose that further research should (a) expand the geographical and cultural scope (exploration of other states or continents, such as Latin America; (b) increase the methodological breadth and depth (quantitative surveys to

reach more participants and participatory observations and ethnological approaches to produce more detailed analyses of the activities); (c) theoretically triangulate the findings (e.g. by using theories from the field of mobile learning (Pachler et al. 2010a) and informal/non-formal learning (Eraut 2000) or social network sites (Merchant 2011) to enhance and broaden the theoretical basis and (d) examine changes over a longer period of time to account for long-term development.

Conclusion

We attempted to provide a fresh perspective on the important role of technology in informal learning contexts for medical education in developing countries. We have shown how, in a very short time, students have adopted mobile technologies, such as mobile phones and small laptops, as cultural tools for educational purposes in ways that were not previously possible. Mobile devices allow learners to enhance (a) situated learning and cognition, by immediately connecting virtual information sources to the students' situated experiences; (b) cross-contextual learning, or learning across multiple contexts by documenting and sharing situated experiences in the form of images and videos and (c) engagement with educational content in social network communities. By placing the students and residents at the centre of the new learning activities, this development has begun to affect the overall system of medical education in the context observed in this study. To better harness this potential, learners should be supported in their critical and reflexive use of these technologies. This is linked to the development of broad media literacy, including the evaluation and creation of content as well as the consideration of ethical and privacy issues.

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Appendix: Semi-structured interview guide

University: practices/activities:

- Could you describe a "normal" day/week during a semester? What are typical activities? (Where do you live? how (often) do you (and your colleagues) go to the classes?
- Describe a "normal" lecture at the university. (Teaching methods, student participation)?
- Are there any differences between you and your colleagues, teachers and patients due to gender, religion, social-caste or any other?
- If you had three wishes with regard to your university: What would you change? Why?

Learning:

- How do you (and your colleagues) learn?
- How do you (and your colleagues) prepare for an examination?
- If you had three wishes with regard to your learning activities: What would you change? Why?

Computer use:

- How do you (and your colleagues) use computers in your daily routines? For what purposes do you use computers?
- What kind of programs/software do you use?
- Do you always have access to computers?
- Do you have wireless access to the internet; for how many hours per day and at which time of the day
- Do you own a computer?
- Where do you work with computers? (Home, universities, other places). why/when not? (technical infrastructure)
- Do you feel competent in using computer and internet?
- If you had three wishes with regard to your computer use: What would you change? Why?

Where do you have your computer skills from?

- Did you join computer training?
- When?
- How many hours all together?
- Was this training helpful for your computer skills?

Docents/Teachers

- Do you have non-Nepalese teachers?
- In which disciplines?

Practical skills:

- Do you have patient-contacts during your study in the 1., 2., 3. and 4th year?
- Do Nepalese patients easily allow to be investigated by students? What are particular difficulties?
- Are there any obstacles from gender, from religion, from social-castes or any other?

Learning material

- Do you easily have access to learning material, like books scripts or any print material?
- Is the material you find in your library useful to students?
- Would you welcome tools for distant learning? Examples are live-video-transmission of lectures from India or other countries; lectures recorded on DVDs etc.?
- Would you welcome distant learning tools from the internet?
- Are you familiar with distant learning tools?

Language skills

- Do you (and your colleagues) normally use English learning material?
- How fit do you think you are in English?
- If you had one wish with regard to your language skills: What would you change? Why?

Final comments

- Have we missed anything important? Do you like to add anything?

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Facebook as a learning tool? A case study on the appropriation of social network sites from mobile phones in developing countries

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Abstract
This exploratory research investigates how students and professionals use social network sites (SNSs) in the setting of developing and emerging countries. Data collection included focus groups consisting of medical students and faculty as well as the analysis of a Facebook site centred on medical and clinical topics. The findings show how users, both students and professionals, appropriate SNSs from their mobile phones as rich educational tools in informal learning contexts. First, unlike in previous studies, the analysis revealed explicit forms of educational content embedded in informal learning contexts in Facebook. Quizzes, case presentations and associated deliberate (e-)learning practices which are typically found in (more) formal educational settings were identified. Second, from a sociocultural learning perspective, it is shown how the participation in such virtual professional communities across national boundaries permits the announcement and negotiation of *occupational* status and *professional* identities.

Introduction and background

Technologies for development and health in "resource-limited" environments

Technological innovations have given hope that new information and communication technology (ICT) tools will result in the overall progress and well-being of developing countries, in particular with respect to health and education services. Great expectations are attached to the spread of mobile communication technologies. The number of mobile cellular subscriptions worldwide is currently 4.7 billion and increasing. This includes people in remote and rural areas and "resource-limited" settings (The World Bank, 2011). To a much lesser extent there is also a discussion on affordances of social network sites (SNSs) in such contexts (Marcelo, Adejumo & Luna, 2011). Discourses and projects on ICT(4)D (information technology for development) or mHealth (mobile technology for health) tend to be based on techno-centric and deterministic approaches where learning materials, either software or hardware, are distributed by central authorities or knowledge is "delivered" according to "push-strategies"; or, using the words of Traxler, information is pumped through the infrastructure, often in "educationally naïve" ways (Traxler, in press). Similarly, the main direction of techno-centric and transmissional approaches appears to be from developed to "developing" countries respectively from experts to novices. In spite of all efforts the situation is still problematic, and ambitious visions have been only realised

Practitioner Notes

What is already known about this topic

- Social network sites (SNSs) support education-*related* learning practices.

What this paper adds

- Learners appropriate SNSs sites from their mobiles as tools for a wide range of educational practices in informal learning contexts in developing/emerging countries.
- The (e-)learning practices identified include deliberate engagement by users with explicit forms of educational content such as quizzes and case presentations as well as participation in virtual *professional* communities that allows for the announcement and negotiation of *occupational status* and professional identities.
- Such technologies permit the students' educational engagement beyond local communities and facilitate loose connections to professional networks.

Implications for practice and/or policy

- Overhasty claims regarding the more systematic use or the integration of such informal (e-)learning in formal educational settings to support education and health in developing countries should be avoided. Instead, more systematic research is needed.

to a limited extent. For example, the goal of providing every person worldwide with access to an informed and educated health-care provider by 2015 is unlikely to be realised. In particular, little progress has been made in meeting the information needs of frontline health-care providers and ordinary citizens in low resource settings (Smith & Koehlmoos, 2011). Very often it is basic knowledge that is needed, related for example to the treatment of childhood pneumonia or diarrhoea, which cannot be accessed by health-care providers such as family caregivers or health workers (HIFA Report, 2010).

With this research we attempt to shed light on aspects of technology use, such as engagement with SNSs and mobile phones, in the context of health education in developing countries, which, we would argue, have been widely neglected. In doing so, we hope to contribute to the academic discourses on SNSs and mobile learning. Since our approach follows the principles of case study research, the remainder of this paper is structured as follows. We continue with a brief and, admittedly, selective characterisation of two underlying academic discourses that can inform this research, namely mobile learning and research on SNSs. After presenting our methodological approach and results we discuss the findings in the light of multiple theoretical concepts and empirical studies from these fields. We conclude with some practical considerations, limitations and directions for further research.

Educational discourses on mobile learning and SNSs

In the field of mobile learning, a small, yet rapidly growing research community, recent work has considered the (educational) use of mobile phones as an appropriation of cultural resources (Pachler, Cook & Bachmair, 2010a, b). In contrast to the classical binary and quantitative model of adoption, appropriation is centred on the question of *how* people use mobile phones once they have adopted them (Wirth, Von Pape & Karnowski, 2008). Researchers define appropriation as the emerging "*processes of the internalization of the pre-given world of cultural products*" by the engagement of learners in the form of social practices with particular settings inside and outside of formal educational settings (Pachler, Bachmair & Cook, 2010a, b). While mobile learning research tend to focus on learning in schools, universities, workplaces or on life-long

learning in industrialised countries (Frohberg, Göth & Schwabe, 2009; Pachler, Pimmer & Seipold, 2011; Pimmer, Pachler & Attwell, 2010), some attention has also been paid to developing countries (see for example Traxler & Kukulska-Hulme, 2005).

Research on SNSs is becoming increasingly popular not only in industrialised nations (Boyd & Ellison, 2007) but, to a lesser extent, also in developing countries (Kolko, Rose & Johnson, 2007). Increasing importance is attached to educational aspects of SNSs (Selwyn, 2009), though there is relatively little theoretical and empirical attention paid by social researchers to the form and nature of that learning in general (Merchant, 2011). Sociocultural approaches to learning in general, and to social networks and mobile learning in particular are based on the notions of participation, belonging, communities and identity construction. It was suggested, for example, that such networks create a "*sense of place in a social world*" (Merchant, 2011) and can be considered as "*multi-audience identity production sites*" (Zhao, Grasmuck & Martin, 2008). By documenting daily episodes by means of mobiles and social networks, such tools are said to contribute to the formation of (multiple) identities related to the live-worlds of users. In this sense, learning is considered as situated meaning-making and identity formation (Pachler *et al*, 2010a, b). The influence of SNSs on practices of social communities was also discussed. An empirical study suggested, for example, that SNSs helped maintain relations as people move across different offline communities (Ellison, Steinfield & Lampe, 2007). Also in formal educational environments, when social networks were deliberately used in order to support classroom-based teaching and learning, (unintended) community building was observed (Arnold & Paulus, 2010). However, research has little to say with respect to vocational and professional aspects of the use of SNSs. One study reported that a company's internal SNS supported professionals in building stronger relations with their weak ties and in getting in touch with professionals they did not know before (DiMicco *et al*, 2008). Another study that observed the use of mobiles and social software for the compilation of e-portfolios witnessed influences on identity trajectory according to the concepts of belonging to a workplace, becoming and then being a professional (Chan, 2011).

Methods

Research approach and methods

This study was conducted as part of a broader research project that explored the role of ICTs in the context of higher education in developing countries, using the example of Nepal as one of the world's poorest nations; in position 157 out of 187 nations according to the Human Development Report (2011). During this project our attention was drawn to the meaning and role of Facebook along with mobile devices for students' private lives and for their learning. Accordingly, with this exploratory research we attempted to address the guiding question of whether and how the use of SNSs can contribute to the users' learning and competence development. In our analysis we drew from two different data sources.

First, data collection including informal talks and on-site focus groups was conducted by two of the authors, CP and SL, in April 2011. Consent was obtained from the institutions involved. Then, the researchers presented their project to interested students and teachers and invited them to take part in the interviews. Data were gained from eight focus groups of three to eight participants ($n = 43$) including 21 medical undergraduate and 9 postgraduate students as well as 13 teachers and faculty members. The student group comprised 11 females and 19 males between 21 and 33 years old (25.3 years on average). Teachers and medical staff were from the following disciplines: dermatology, physiology, surgery, psychiatry, radiology, paediatrics, anatomy and medicine. In order to make the group representative of university population, we involved participants from a private (Nepal Medical College & Teaching Hospitals) as well as from a public university (The Institute of Medicine/Tribhuvan University) with affordable fee structure (Bajracharya, Bhuju & Rokhrel, 2006).

The interview guide included a broad set of questions referring to the use of ICT by undergraduate and postgraduate students for medical learning, working and leisure time. The use of SNSs and mobiles for learning was not anticipated. The topic emerged in the first focus group and was then explicitly addressed in the subsequent conversations. The interviewer asked the participants about their general use of mobiles and SNSs, about associated learning practices and perceived learning effects. The interviewed persons were fluent in English, since English was the working language in Nepalese medical education.

Second, we contrasted the material with the analysis of a Facebook site centred on medical and clinical topics, namely Medical Profession, wow I Love it (http://www.facebook.com/Medicalprofession); a site which several of the interviewees along with many other users (Facebook use = 'fu') indicated that they participated in. While we were not able to track the exact behaviour of the interviewees on that site, the analysis allowed for a much broader exploration of learning and teaching practices of a large number of medical students and doctors mostly from developing countries or emerging nations.

The interviews were audio-recorded, transcribed verbatim and entered along with the field notes in the qualitative data analysis software NVivo8 (Lewins & Silver, 2009); the data of all activities of the indicated Facebook site from October to December 2012 were also downloaded and analysed:

In accordance with inductive principles of qualitative data analysis (Pope, Ziebland & Mays, 2000), one researcher read and reread the data sets to identify themes. The other researchers independently read and interpreted approximately 30% of the data. Insights and findings were jointly discussed, contrasted and interpreted until consensus was reached. The following of the identified themes were selected for further investigation: the use of (1) SNSs and (2) mobile phones as a common practice, (3) the use of explicit forms of educational content on SNSs ([a] quizzes, [b] cases, [c] instructional images and [d] videos) and (4) participation and expression of professional identities on SNSs (triggered by [a] jokes and [b] direct questions). With respect to the findings from the focus groups, respondent validation was conducted by sending an overview of the results to all participants. They confirmed the interpretation and made minor comments that did not require changes of the manuscript.

Ethical considerations

As there was no formal framework for ethical approval available, consideration of ethical issues was given by an expert outside the research group, a professor for ethics at a Swiss university who was part of a Swiss ethical review board. With respect to the perceptual data (focus groups), it was his expert opinion that our work did not contravene the Declaration of Helsinki (World Medical Association, 2012). He did, however, identify questions related to *Ethical Legal and Social Issues* such as quotations where participants reported documenting and reusing patient-related data by means of private technologies. He emphasised that anonymity must be ensured so that no plausible harm can arise from the study to the interviewed groups/participants. He suggested concrete measures to make it impossible even for persons involved in the research project (others than the interviewers) to link any statement to individuals and groups. Accordingly, information such as the organisation, group size and dates of the focus groups, which we originally included, was removed.

Upon advice from the expert we took the following approach regarding the analysis of the Facebook site. We deemed the information to be public as the site was publicly available to everyone without any restrictions. We did not consider any material from the users' personal sites such as profile information, wall sites or photo pages. Instead, we only extracted data from the site indicated. Similarly to MacDonald, Sohn and Ellis (2010) we did not participate covertly, and we did not claim to be, or attempt to become, "friends" of members of the site. In quoting text from

the site we did not disclose (user) names of individuals so as to protect confidentiality (Moreno, Fost & Christakis, 2008). Similarly, we made persons' faces unrecognisable on the photographs.

Results

First, we analyse how Facebook and mobile phones have influenced the daily routines of the interviewed students and have thereby affected their media-related practices. In the main part of the analysis we show how such technologies were used for learning purposes.

Use of Facebook and mobiles

Mobile Facebook use—a daily practice

The analysis of the interviews showed that, apart from a few exceptions, nearly all of the interviewed students used Facebook on a daily basis. In addition, Facebook was reported to be broadly accessed also by the interviewees' friends and relatives, by people across (nearly) all age groups. Most of the students use Facebook by means of their mobile phones and to a lesser extent via laptops.

> We use it [Facebook] all day from the wireless [mobiles] not from the laptops. (undergraduate students = "us")

Facebook was said to be the most intensively used tool—in comparison with other platforms and communication tools. Many of the interviewed students indicated accessing Facebook several times a day, and some even associate the use of Facebook with a state of dependency: "*All day. Every day. It's an addiction*" (us). In updating their status, uploading images and writing comments, the students used Facebook predominantly for entertainment and communication with their social environment.

Mobile Facebook as a catalyst for changing communication practices

The empirical analysis revealed the considerable extent to which Facebook use impacted on information and communication practices. Interviewees considered Facebook as a catalyst for using (mobile) Internet, and, similarly, for a radical and quick transformation of media practices. It was reported that Facebook motivated them to activate the Internet on their mobile phones. Upon activation, Facebook was deemed as one of the main reasons to access the Internet.

> The reason why most of the people have activated the internet on their SIM card is because of Facebook. (us)
> [I use the internet] every day. For Facebook, for the status. (us)

Facebook as a learning tool

During the focus groups some of the students indicated using Facebook for learning purposes. They reported accessing specific sites and groups on Facebook and engaging in discussion on medical and clinical topics.

> A group "Medical profession, I love it." That's a group. I'm part of the group. (Postgraduate students = "ps")

Medical Profession, wow I Love it is a relatively popular Facebook site. At the time of the study it saw more than a thousand interactions per week. Many of them were created by users, medical students and professionals, from developing and emerging countries such as Nepal and India. The analysis of this site revealed, amongst a few non-medical topics and non-education-centred postings, a considerable number of interesting themes that directly related to learning. In the following sections we will present and exemplify major findings from the analysis of the site and contrast them with data from the focus groups.

Explicit educational content and deliberate learning practices

Many of the site's active users used the "wall" and associated posting and commenting functions to engage in quiz questions. We identified a considerable number of postings with open and closed quiz questions from a broad spectrum of medical topics. Typically, the following course of action

Figure 1: Two forms of quiz questions on Facebook walls

was observed. A user, often the convenor of the site, posted a question. Then, other participants provided their answers in the form of comments. After a little while the initiator of the question posted the "correct" answer, also in the form of a comment. Figure 1 (left image) shows such a question that relates to a new medication for children with diarrhoea. The interviewed students described these practices in the following way:

He [convenor of the site] asks questions to medical students. [. . .] I answer by myself. [. . .] Finally he used to give the right answers. (ps)

As the analysis of the site showed, many questions received a great deal of feedback and were, accordingly, answered, commented and recommended by a large number of users. Questions where learners were uncertain about the correct answers, or questions of a high level of interest were reported being shared with other users:

If we have questions and we are not sure about the correct answers we can share it with our colleagues. (ps)

Beyond the engagement with quizzes, the site was also used for the discussion of short case presentations considered as "*interesting cases*" (ps). There, a case typically including information such as anamnesis and first diagnostic findings was briefly introduced with an invitation to post possible diagnostic and/or therapeutic decisions. Pictures were also uploaded so as to illustrate cases and quizzes (Figure 2). Again, learners posted their answers and recommendations in the form of comments. These activities were followed by the initiator posting the "correct" answer.

Interviewees did not consider quizzes and cases, which included a broad range of basic clinical knowledge, as particularly complex, "*Usually there are not tough questions*" (ps). They deemed the engagement with educational content in the form of questions and images as relevant for their learning and considered it as a learning opportunity in addition to their formal medical education or more specifically, their textbooks.

There are so many things we don't know from the textbooks. G: Even some simple things. (us)

In addition to the embedded educational content we also identified a number of links to medical information resources outside Facebook such as e-books or videos.

Sociocultural aspects: participation and expression of professional identity

In addition to explicit forms of educational content the analysis of the site also revealed a number of aspects centred on participation and professional identity, which relate to a sociocultural understanding of learning. Yet the name of the site "Medical Profession, wow I Love it" indicates a positive connotation to the medical profession. Further examples included particular questions or cartoons and jokes that related to the understandings of medical students and doctors of their own professional identities. This is exemplified, for example, by the feedback and responses provoked by the question, *"Proud to be in this profession, what about you?* This comment was posted by the convenor of the site, and received more than 60 comments and 200 "likes." In addressing the questions, users mostly showed agreement and demonstrated high professional identification and

Figure 2: Case presentation

professional membership. In doing so they also pointed to professional challenges, emphasised professional norms and professional codes of conduct, as shown in these three statements:

yesss.bt its nt be easy thre way iz vry tough whn u make a good doct. othrwise itz the best profession in the world.bt doct should be polite,gentily care and serious [. . .] (Facebook user = "fu")
i'm very proud and love this profession very much . . . though very tired and many problem we have to solve. but still. I'm proud and love it . . . (fu)

On the site observed the discussion of professional themes was not a singular phenomenon, as also alluded to by the following posting: "*how many times this question is asked on this page . . . any idea?lol.*" Similarly, cartoons and jokes provoked reflection on and engagement with the users' professional identities and their occupational self-perceptions and status. They caricatured medical disciplines or, as illustrated by Figure 3, medical doctors in general:

The comments of more than 90 users on this cartoon (Figure 3, January 11, 2012) demonstrate the high level of feedback and illustrate how medical students and professionals compared and negotiated their professional self-concept—on the basis of their professional experiences—referring to the messages from the cartoon. Some of the users fully agreed with the message of the cartoon. For example, a user appreciated the opportunity provided by professional identification and deemed it as valuable support in a difficult occupational situation "*feeling crap*." Other users only partly agree and signal differences to their own professional (self-)understanding.

sure im proud and love my work and in good relation with my patient (fu)
This pic pretty much describe my life, thanks [. . .] for making me realise I am not the only one feeling crap right now. (fu)
no life . . . i agree . . . no money i dont agree:) (fu)

Figure 3: Cartoon triggering discussion on professional identity and occupational status

Level of participation and interaction

As indicated, considerable interaction was observed on this site. Some posts received a few hundred comments and even more recommendations in the form of "like." Statistics show that since the creation of the site in May 2010 it has been recommended by more than 36 000 users and that in the last 7 days there was a total of 1750 interactions on the site (December 24, 2011). The convenor fostered participation and interaction also in the form of nominating a "fan of the week," a user who shows particular engagement with the site. As indicated, a few users, often the convenor of the site, made initial contributions, while the majority responded and provided feedback. In the same way the interviewed students perceived their role as mainly reactive, including answering and commenting on statements from others. This is interesting as, from a technical standpoint, every user was enabled to make initial contributions.

I haven't contributed to questions. I only answer questions. [. . .] I think that we are only allowed to answer. (ps)

In the interviews, younger teachers and younger faculty members also reported regularly using Facebook for professional learning purposes, and deemed the platform as an appropriate tool to share medical information with (professional) colleagues.

We share a lot of medical information on Facebook. We share videos. And sometimes some of our friends get free downloads of books. So we share that. Facebook is a good medium to share much medical information. (teacher/faculty)

This view was also confirmed by the analysis of the Facebook site, as we have already indicated that beside students, mostly medical doctors participated. We also found occasional questions by patients asking doctors for diagnostic or therapeutic advice.

Discussion

In the following sections we discuss the use of Facebook sites along with mobile phones as educational tools through different theoretical and conceptual lenses and, lastly, we conclude with some practical considerations, limitations and directions for further research.

Appropriation of Facebook and mobiles for deliberate (e-)learning practices

Drawing on the work of Merchant (2011), who distinguishes learning *about*, *from* and *with* SNSs, the way learners used technologies in the manner observed clearly relates to the last form. Empirical studies identified different forms of learning with, or, as we would prefer, "through participation in" social networks such as developing and demonstrating new literacies (Greenhow & Robelia, 2009). However, the exchange of factual and more academic forms of knowledge in informal learning contexts has been reported to a limited extent. For example, one fifth of university students, typically "newcomers," exchange information *related* to their studies by seeking contact with other students as well as orientation in their new environment (Wodzicki, Schwämmlein & Moskaliuk, 2011). In the field of medical education a study reveals that one quarter of the students used Facebook for educational reasons (Gray, Annabell & Kennedy, 2010). Another study that also reports education-related aspects in the use of SNSs by students has found factual and more academically oriented information, although to a lesser extent (Selwyn, 2009). Similarly, it has been observed that students' Facebook engagement were for social reasons, but not for "relatively" formal learning and teaching (Madge, Meek, Wellens & Hooley, 2009).

Surprisingly, in the site explored there is much evidence for explicit forms of educational and academic content and associated learning and teaching practices such as the engagement with quizzes, case presentations or the exchange of external multimedia learning resources via links; These are deliberate practices and explicit representations of knowledge and learning which we would typically expect in e-learning platforms or learning management systems and associate with classic approaches to (higher) education in formal learning contexts. This might to some extent confirm the findings of Gray *et al* (2010) who reports that medical students use Facebook groups to interact with university colleagues in educationally conservative ways. However, there, the students do not interact across their institutional boundaries and do not connect to more professionally oriented communities (Gray *et al*, 2010). As discussed, in the context of our on-site research as well as in developing countries in general, ICTs tend not be integrated in (medical) curricula or in teaching practices, for example, due to the limited availability of computers and Internet facilities (see for example Kommalage & Gunawardena, 2008). In view of these affordances medical students and professionals have quickly appropriated SNSs as relatively formal (e-)learning platforms in informal learning contexts in ways beyond those for which such technologies were originally designed.

Participation in professional communities and formation of professional identity

Aspects related to *expression* of *professional* identity, belonging to and participation in *professional* communities appear to be inherent parts of the site observed. We have shown how engagement and participation in such wider, virtual *professional* communities by means of mobiles allows for the announcement of *professional* identities (Zhao *et al*, 2008) and, at the same time, includes discussion and negotiation of professional identities as part of the (professional) self-concepts. Similarly to Chan (2011), who has conducted research on the use of mobiles along with e-portfolios in social network environments, we suggest that such sites can provide opportunities for expressing and negotiating individuals' professional identity. Chan also found such technologies suitable to enhance self-recognition of transformation and trajectories of vocational identities. In addition, she considers the collection of evidence by means of these tools as affordances for the research of such trajectories, and, more in general, for the exploration of situated learning. The Facebook site which we observed was, however, rather centred on the unsystematic presentation of topics than on the development of individual users and did, accordingly, not allow for the exploration of longer identity trajectories. It did, however, enable spontaneous forms of announcement, discussion and negotiation of occupational status and professional identities in

the context of a wider community of medical students and doctors across national boundaries. There, the meaning of community differs considerably from the classic notion established by Lave and Wenger (1991). While they concentrated on "real-world" communities, and only at a later point in time discussed how information technology might support existing communities (Wenger, White, Smith & Rowe, 2005), the observed SNS was mainly based on virtual relations (without an offline community) where learning and participation appeared to be far more short-lived and ephemeral; putting it in the words of Lave and Wenger (1991), most of the members would rarely move from peripheral to more central (respectively active or instructive) forms of participation. Also, participation observed on the site cannot be considered as belonging to workplaces (Chan, 2011) but rather to (other), less intense professional communities. However, we would definitely interpret the participation of learners in multiple professional communities as one characteristic of an "expansive" (and learning rich) environment (Fuller & Unwin, 2004).

Blurring educational boundaries and the redistribution of knowledge and power?

The practices observed also illustrate blurred boundaries between different cultural practices such as entertainment and learning, noted by Pachler *et al* (2010b). In the focus groups it became clear, however, that knowledge and expertise developed outside educational settings (for example on Facebook) was not taken into account in the context of formal (medical) education. Teachers and faculty did not report to integrate the Facebook activities of the students into formal learning practices, and the access to SNSs was even banned during lectures in one of the universities. During these hours students accessed Facebook mainly by means of telephone networks. In this sense, the blurring of boundaries (still) occurs in a rather unidirectional way. Our research has also shown that formal educational institutions are "*no longer the gatekeepers of* [what we would consider "formal"] knowledge" (Pachler *et al*, 2010b). We would attach even greater importance to this transformation in resource-limited settings, where access to formal forms of knowledge and learning resources has been typically restricted to teachers and (a few) books in libraries. Our data also support the view that social mobile learning practices can, according to Pachler *et al* (2010b), be characterised by distributed resources, power and practices across life-worlds and lifestyles. Practices were also distributed across local and even national contexts, as most of the participants of the observed Facebook site appeared to be located in developing and emerging countries. However, power in terms of structuring interactions on the site appeared not to be equally distributed across the users. The rather reactive behaviour of the interviewed students may reflect to a certain extent, existing cultural and educational patterns, which are characterised by a relatively large power distance in Nepal. For example, Nepali students consider teachers as higher in the hierarchy and tend not to ask questions (Lemone, 2005). This also reflects the findings of Zhao *et al* (2008) who suggested that in Facebook individuals tended to behave according to established norms.

Pedagogical, ethical and practical concerns and further research

Mobile phones and SNSs are technologies that are reaching more and more people also in developing countries. We have shown how learners in such contexts appropriate (and do not solely adopt) technologies for their learning. They take part in professional communities and access basic medical knowledge according to pull-strategies (they select when and how to engage). We have revealed interesting and, to date, to some extent underexplored aspects of technology use for (health) education in developing and emerging countries, and we hope and believe that this might also provide fresh perspectives on development approaches, which tend to distribute technology or "transmit" knowledge and thereby are inclined to neglect sociocultural characteristics.

Nevertheless, from a practical perspective, these considerations by no means permit the seemingly obvious conclusion that such technologies should be recommended without reservations or that they might even be used more broadly and systematically. On the contrary, in view of ethical, legal

and privacy issues, and against the background of a number of pedagogical limitations we deem the (systematic) use of commercially oriented software in the context of health education in developing countries as highly problematic. A critical aspect is, for example, the question of quality control. In Facebook there are no mechanisms provided that help to ensure the quality and trustworthiness of learning contents presented. Accordingly, there is, apart from critical peer feedback, no protection against problems inherent in poor or wrong advice being given and followed. And, if such educational material is simply copied from other sources (for which we found some evidence), copyright laws are likely to be violated. From a learning perspective, knowledge was presented unsystematically (compared with formal learning contexts) and was not linked to any specific curriculum or to the learners' previous knowledge. Also, we would argue that Facebook did not facilitate deep engagement of learners in the form of interactive in-depth discussions: "Walls," which were used as discussion boards, only allowed one level of interaction, ie, it was not possible to re-comment on existing comments and, accordingly, to build threads. Similarly, Friesen and Lowe (2012) argued that Facebook, as a commercial tool, does not foster disagreement and debate but produces interactivities characterised by conviviality and "liking" and is, therefore, a questionable tool for education. (There are a number of other pedagogical and ethical limitations, whose discussion would go well beyond the scope of this paper). Our analysis has also provided no solutions regarding how the "informal" practices might be aligned with learning in formal contexts. We suggest that such learning should not be ignored but explicitly addressed in the classroom and critically discussed with respect to media literacy. Both learners and teachers should be systemically supported in considering opportunities, risks and limitations. Harnessing such affordances for learning strongly depends on (the development of) broad media literacies with respect to evaluation as well as creation of content (Livingstone, 2004).

From an academic perspective, very little is yet known about the phenomena explored. For example, even if the site observed shows considerable interaction, we do not know how many Facebook users engage in educational practices. It has to be acknowledged that we only analysed one of many Facebook sites that are centred on clinical and professional topics. Examples of other sites are Faculty of Medicine an even more active community, or sites with users from special cultural and regional backgrounds like Arab Medical Doctors or Medical Jokes, a site explicitly dedicated to cartoons and jokes about the medical profession. Accordingly, future research should analyse such sites more broadly and may also consider sites centred on other professions in platforms other than Facebook. In view of the pedagogical limitations identified, we also suggest more in-depth research addressing the extent to which the engagement with such sites impacts on learning and can inform (clinical) practice. Also, the underlying motives of users, those of both learners and "teachers" on such sites should be researched. Accordingly, we are fully aware that with this research we have neither been able to explore the topic in great detail nor to provide definitive accounts of the phenomena observed. We hope, however, that we have been able to provide a rich jumping-off point for future explorations.

Conclusion

The interviewed medical students in resource-limited environments consider the use of Facebook from their mobiles as a daily and highly popular practice. Some of them also appropriate these technologies as educational tools, along with many other users, students and medical professionals, from across developing and emerging nations. The analysis of the interviews and of a Facebook site centred on medical and clinical topics revealed rich (e-)learning and (e-)teaching practices in informal learning contexts. First, unlike previous studies, we identified explicit forms of educational content such as quizzes and case presentations which were embedded in Facebook and associated with deliberate (e-)learning practices in informal learning contexts. One would

typically expect this type of learning in (more) formal educational settings. Second, from a sociocultural learning perspective, we have shown how the participation in such virtual *professional* communities across national boundaries also allows for the declaration and negotiation of professional status and professional identities. In pointing to the importance of exploration and the acknowledgement of existing "technology-enhanced learning" practices, we hope that this research might also provide fresh perspectives to development projects, which tend to disseminate technology and "push" knowledge to learners. However, research on the phenomena at hand needs to increase in both depth and breadth. It requires a number of ethical issues to be considered before any definitive accounts related to the effectiveness of such tools on health, education and development in "resource-limited" settings can be given.

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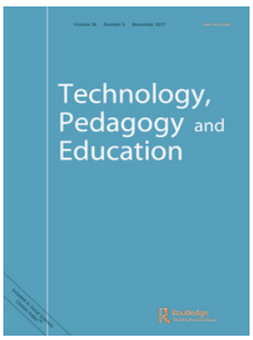

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Facebook for supervision? Research education shaped by the structural properties of a social media space

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Facebook for supervision? Research education shaped by the structural properties of a social media space

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ABSTRACT

This study analyses the use of a group space on the social networking site Facebook as a way to facilitate research supervision for teams of learners. Borrowing Lee's framework for research supervision, the goal was to understand how supervision and learning was achieved in, and shaped by, the properties of a social networking space. For this purpose, the discourse between supervisor and learners was analysed along with the structural properties afforded by the space. Using the empirical findings and further literature, a conceptual framework was developed that illustrates the ways in which functional supervision, enculturation, emancipation, critical thinking and relationship development are achieved and formed by the interplay of the technological, functional, multimodal and the wider sociocultural, political and sociolinguistic structures associated with social media space.

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Introduction

With the ever-increasing adoption of social media – in particular, of social networking sites – and the appropriation of these tools in students' life worlds, more and more educators are starting to use these new technologies to enhance their teaching activities (Manca & Ranieri, 2013). The goal of this research is to explore how the use of a social media space, such as a Facebook group, supports teams of learners to develop analytical and research skills. In contrast to studies that ascertained how the use of social media impacted educational outcomes, this study aims to create an understanding of how learning and supervision are actually constituted in the social networking space and shaped by the properties of this space. The underlying tenets of this study are introduced, first, by problematising the notion of research supervision. Then, the dominant literature on digital media use (in particular social media) in research supervision is synthesised. Finally, we outline what previous literature has to say about how the structural properties embedded in digital spaces shape online engagement. The presentation of the results is followed by a theoretical discussion.

Literature review

Research supervision

Pearson and Brew (2002) argued that, along with the increasing importance of research to facilitate innovation and economic development, research education has taken a more prominent position for

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governments and the general public. The role of research supervision is to enable students' development towards becoming independent and critical researchers in their respective fields (Evans, 2009). Supervision is not simply the cooperation of more experienced researchers with less experienced researchers. Instead, it has been described as one of the least discussed but most complex and advanced formats of teaching (Connell, 1985), which has explicit didactic elements (Pearson & Brew, 2002) that play out in complex communicative environments. How to facilitate what has been defined as skilful research performance is by no means straightforward. In the context of supervision, teaching strategies are often referred to as mentoring or coaching, although these are ill-defined concepts with blurred boundaries (Pearson & Brew, 2002). A more palpable theoretical framework that describes different qualities of the supervision process was elaborated by Lee (2008). Drawing on her analysis of doctoral supervision, she distinguished five core elements of supervision: (1) *functional supervision*, where the focus is on project management and where the supervisor helps students to progress through tasks; (2) *enculturation*, supporting students in their trajectory of becoming members of the disciplinary community of researchers; (3) *critical thinking*, where the student is guided in problematising and questioning their own and others' arguments; (4) *emancipation*, helping learners to question and develop themselves; and, finally, (5) developing a quality *relationship*, where the student is enthused, inspired and feels cared for (Lee, 2008). Another important element, beyond the communicative one-to-one relationship of supervisor and learner, is the conceptualisation of research groups and networks as communities of practice (Lave & Wenger, 1991). Communities of practice enable research students to learn from significant others, such as peers, technical staff and the wider community (Pearson & Brew, 2002). Community of practice perspectives conceive learning to be a form of sociocultural participation through which a learner develops from an outsider at the periphery of a community to an 'insider'. The learner becomes a core member by assuming more and more central tasks (Lave & Wenger, 1991).

The use of digital and social media to facilitate research supervision

There is very little research that explicitly focuses on the use of digital and social media for research supervision. In his overview of using technology for remote research supervision, Sussex (2008) distinguished between different technologies, such as emails or bulletin boards, according to synchronicity and according to whether written or spoken language is facilitated. While Sussex emphasised the ability of media to allow for interaction and discussion, he made no reference to Web 2.0 concepts or to social media. Importantly, Sussex emphasised that supervision interactions in digital spaces should not be ephemeral, but ought to be documented as an enduring record of the supervisor's guidance. He suggested that this can be achieved through written documentation of the supervisor's editing or notes, and the student's own notes on those notes to allow the supervisor's recommendations to be incorporated into the student's work. In her conceptual paper, Le (2012) suggested that the use of e-portfolios can enhance students' academic development, research profile and social networking. She argued that e-portfolios should include a private section for the learner and supervisor, where parts of a thesis can be uploaded and critically discussed. Beyond the dyadic supervision relationship, they should provide spaces for networking with the wider research community and students can use them to showcase their academic achievements and sharpen their professional profile (Le, 2012). Examining social media-based research supervision, Chong (2010) reported on the experiences of undergraduate students who interacted via blogs with their teachers while writing a research paper. The author found in his small-scale, qualitative study that the features of blogging enhanced traditional face-to-face support by enabling closer monitoring and more timely feedback. A South African study evaluated the use of a learning management system for research supervision in a blended-learning setting (De Beer & Mason, 2009). While the learners did not study the reading resources provided intensively, they appreciated the online feedback on their assessments and the availability of immediate support, independent of location and time. This brought them closer to their supervisors, making supervision a more integral part of their research (De Beer & Mason, 2009). Similarly, Ngaleka and Uys (2013) applied Ten Have's (2007) conversation analysis to examine how groups of South African students used the mobile social

media application WhatsApp for group conversations about their research projects. They found that the students' use of technology facilitated collaboration and learning outside of the classroom that manifested in good working relations. They identified particular, close to real-time communication patterns associated with the structural affordances of WhatsApp groups that allowed students to act as 'speakers' and 'listeners' at the same time (Ngaleka & Uys, 2013).

Structural affordances of social media

The literature on the educational use of social media, in particular with Facebook, is mushrooming. This is reflected by an increasing number of empirical studies and reviews (see, for example, the reviews of Ranieri, Manca, & Fini, 2012; Tess, 2013). Most of these studies consider social media environments as either neutral spaces where interaction can unfold freely, reflecting instrumentalist views and tool metaphors (Surry & Baker, 2015); or, as spaces that favour networked and connectivist learning across pre-established boundaries, reflecting approaches of 'soft' technological determinism (Selwyn, 2012; Surry & Baker, 2015). As noted by Manca and Ranieri (2013) in their review, the focus of the studies is on instructional uses and efficacy, for example with respect to content delivery, community-building, informal learning, academic conversations and learning outcomes, as well as on students' and teachers' reactions to the space, for example in terms of motivation (Vikneswaran & Krish, 2015).

However, as Robson (2015) rightly noted, there is only a limited (though increasing) number of studies that scrutinise the distinct properties associated with social media platforms and the ways in which these afford and inhibit communication and learning. This is rooted in the understanding that digital platforms are never neutral, de-contextualised and value-free. Instead, platforms carry ideological, political, sociocultural and economic baggage (Surry & Baker, 2015). This is reflected in the very nature of their technological and functional design. Unveiling these underlying, often subtle and opaque, structures is perhaps grounded in what Selwyn (2010) described as the critical study of educational technology. In this article we are using an approach that understands that digital media is subject to complex interactions and negotiations with the social, economic, political and cultural contexts that it emerges in (Selwyn, 2010). In this respect, Robson (2015) demonstrated how the engagement of teachers in online space is shaped through technical design and functionality, the dominant social discourses of the user group, and the agendas of the organisations that provide the space. In addition, multimodal social semiotic perspectives can help to understand the complex dynamics in which interaction is shaped in social and technological spaces, paying attention, for example, to the notions of power, authorship and reading paths (Domingo, Jewitt, & Kress, 2014). They illustrate how writing online in a blog unfolds according to the ways in which people use the 'pre'-designed multimodal potentials and constraints of the technological platform as a resource for meaning-making. The interrelation of technological and sociocultural structures (for example, technological infrastructure and the wider curricular frames of institutions), along with the users' practices and agency, form the core of the triangular framework of mobile learning elaborated by Pachler, Cook, and Bachmair (2010).

In summary, this study seeks to contribute to the scarce literature available which examines the use of digital media in research supervision by exploring the conversational and structural affordances, as well as the constraints of a social media space.

Methodology

Research questions

This research draws on an intervention that used a social networking site as a tool to facilitate research supervision of teams of learners in a marginalised setting. More specifically, nurses in an advanced midwifery programme in rural South Africa were supported in the development of their first research proposal. The two interrelated research questions were:

(1) How did research supervision and learning unfold in the written interactions between students and supervisors?
(2) How did the embedded and wider structural properties of the space shape this interactional achievement?

Participants and setting

The setting for this intervention was a module that focused on developing the analytical and research skills of nurses enrolled in a part-time, advanced midwifery education programme in rural areas of KwaZulu-Natal province, South Africa. The learners ($n = 47$) were experienced nurse practitioners, albeit with very limited research knowledge and with limited prior exposure to and use of social media spaces. English was the learners' second language.

The educational intervention

As part of the research module, five teams of learners were required to jointly develop a concept paper for a research proposal on a topic of their choice that was relevant to their professional environment. The practice-oriented development of analytical and research skills through training and supervision of health professionals is key in these settings. It advances these professionals from consumers of pre-defined knowledge to 'generators' of new insights into and solutions for their local health service environments. The role of supervision here was to facilitate local capacity-building, what Pachler and Redondo (2012) characterised as 'equipping professionals to be able to identify problems pertinent to their context, ask the right questions, know how to seek to answer them systematically' (p. 463). The teams were guided and supervised in developing the concept paper over five months by a skilled research academic with the sporadic support of a second academic when the main academic was unavailable. The supervision was carried out exclusively in a closed group on the social networking site Facebook and lasted from the end of January to June 2013. To promote mutual interaction and learning across the teams, all teams were invited to be in the same social networking space.

Analysis of the social networking space

To understand the ways in which supervision and learning unfolded in the social networking space, semi-grounded discourse analysis was conducted using the theoretical conceptions of Lee (2008) as a priori concepts (Mayring, 2004). By analysing the conversation patterns, learning was not measured as a mental phenomenon. Instead, it was measured in the ways that understanding and meaning were achieved in written interactions between learners and supervisors in this digital space, or as 'interactional achievement' as coined by Koschmann and LeBaron (2002).

To obtain a richer understanding of the ways in which learning and supervision were constructed in the social networking space and to account for multimodal social semiotics perspectives, analytical attention was paid not only to the written interactions, but also to the constraints and potentialities of the embedded and wider structures of the digital environment. In so doing, and in addition to Lee's conceptualisations (2008), concepts from the work of Domingo et al. (2014) were used in a semi-grounded approach, including the ways in which authority is shaped by the design and use of navigational features, linearity, modularity and reading paths, and in which the internal written interactions can be connected to wider political and cultural notions. To do so, content including images, links and written conversations was imported into and analysed in NVivo 8.™

Findings

Most learning in the social media space was constituted through interactions between learners of the teams and the supervisor. This means that the learners articulated and re-articulated elements of their

team's research proposal upon prompts from the supervisor. The main ways in which supervision and learning were achieved are conceptualised and illustrated in the succeeding sections, drawing on Lee's (2008) framework.

Functional supervision

In this section the category *functional supervision* is presented. Functional supervision describes the ways in which the supervisor supported students in the rational progression of their tasks through topical feedback and meta-supervision. In the second part of this section it is explained how the supervisor's attempts to provide clarity and direction were undermined by the embedded sequencing mechanisms of the social media platform.

In the data, a large number of conversations could be associated with functional supervision. This manifested either in the form of concrete topical feedback by the supervisor on a specific excerpt of a group's research proposal (for example, the research question) which had been posted by one of the group members; or as meta-supervision, such as providing an orientation for the overall process. A form of topical direction was provided by 'adjusting prompts'. An example of this would be the supervisor giving precise instructions and specifications as feedback which guided learners to adapt and add distinct elements to their research concepts, such as the request: 'Change 2. to identify the number of possible avoidable [Caesareans]…'.

The supervisor provided meta-direction by setting the goals of the exercise, describing expectations of how the platform was to be used and emphasising the progress of different groups. She used the latter as a benchmark and as a way to motivate others, as the following quote exemplifies: 'M groups are off to a great start. Thanks for that. Can we hear from the other ones too?'

Although with these, and related prompts, the supervisor sought to drive and guide the different teams in a direct way towards the goals of the educational activity, clarity and direction were undermined by the embedded mechanisms through which the reading paths of the Facebook group were construed (at the time of the study). Although postings and comments were added linearly at first, an old post was immediately repositioned at the top of the page as soon as it received a new comment. Although this mechanism helped to direct the users' attention to the most recent contributions, it resulted in communicative de-contextualisation. In other words, stable and chronologically ordered reading paths that would have provided insights into the groups' progress over time were constantly overwritten by the principle of novelty. This manifested in a lack of cohesion and turn-taking in a number of dialogues between learners and the supervisor. For example, in questions that remained unanswered, in instructions that needed to be restated or in repeated attempts to establish and continue conversation threads, as shown in the comments below:

> Student: Hai [supervisor]. [Group B], have you seen our purpose of the study and the objectives you have asked
>
> Supervisor: … I don't have your objectives. Please post them again …
>
> Student: Okey A [supervisor], group 2 D Site again. we have posted you previously the aim of the study and objectives […] and yo [your] response said 'write out the objectives using a verb eg to measure […]'.

The last quote exemplifies how group members and supervisors invested time and effort to establish continuity and referentiality within a structure which was constantly reshaped. As the above statement also illustrates, the group needed to partly reproduce the history of the conversation, which resulted in redundancy and in relatively high asynchronicity costs (Clark & Brennan, 1991).

Enculturation and emancipation

Enculturation is the dynamic through which learners become members of an academic discipline. Lee (2008) considered emancipation to be approached when the supervisor's guidance becomes more and more obsolete. The facilitation of enculturation means sensitising learners towards the discipline's epistemological demands, which they can then follow relatively independently. Arguably, while the

very inexperienced research students did become more independent during the intervention, they did not reach any point close to the level outlined above. In contrast to the high number of conversations that featured functional supervision and critical thinking, there was, in general, less evidence pointing to enculturation. In the discourse, the supervisor inextricably intertwined immersion in a community of researchers with the use of exclusive language, as the following examples illustrate:

> Please post in proper English – not sms language

> You need to write in research language. The aim of the study is to […]

These articulations refer to language as a constitutional element of the research community and its demarcation to other cultural groups – those of non-researchers. In other words, the normative tonality of the instruction can also be regarded as an explicit invitation for students to learn and apply language to become a respected member of the community. This would make them a good researcher, achieving what Lave and Wenger (1991) labelled 'legitimate and more central participation'. The analysis revealed that there were actually two competing 'languages' that co-existed in the social media space: firstly, an informal and colloquial idiom which tended to be used for interpersonal communication among the group ('… bad coz its 4 da first tym'; 'thanx 4 da cul weather') and also for communication with the supervisor about the research ('*i'm [!] lost whether u [!] want us..*' we have 2 [!] specify'). Secondly, a more formal language was used in which learners explicated different elements of their research proposal. However, the more academic language in which the research statements were made also contained 'slips of the pen', for example incorrect use of upper- and lower-case letters, which is very typical of the colloquial language used in SMS communication (Chaka, Mphahlele, & Mann, 2015). An inherent tension was produced through the use of a personal space, which is usually tied to very informal and colloquial language, and the requirements that arise from its appropriation for more formal and, in particular, research purposes. This makes it into a domain where, as discussed above, enculturation is based on the use of a very exclusive language.

Critical thinking

The facilitation of critical thinking is at the core of research supervision. Students are encouraged to ask and answer questions and to problematise and critique their own and others' conceptions. Critical thinking was a dominant category in the data. It was triggered by the supervisor's technique of deepening by asking 'how' and, to a lesser extent, 'why' questions. These prompts required learners to legitimise and substantiate their conceptions and triggered reflection, as the following example illustrates:

> Student 1: […] revised objectives [..]..To: 1.Describe the prevalence of c/s done at L's hospital from Oct. 2012 to March 2013. […].

> Supervisor: Good – how will you define avoidable C/section – what will the operational definition be?

> Student 1: avoidable c/section.is based on the facts that some patients refuse VBAC, they believe once a caesarian always will be and lately doctors send all breech deliveries for c/section without proper pelvic assessment in spite of availability of u/s. hope I'm answering your question.

> Student 1: An avoidable c/section is the one where a patient could deliver vaginally with no foreseeable risks. [Liked by the student]

Student 1's posting is an attempt to define an avoidable Caesarean section. Her first approach represents, however, not a precise definition but rather a broad description of its circumstances. In this light, the amendment 'hope I'm answering your question' can be interpreted as the learner's uncertainty towards her first conceptualisation. In fact, 10 minutes later she came up with a new, revised definition, which was much more focused. This time, the learner also expressed her conviction by 'liking' her second comment. As illustrated by this example, questions such as 'How will you go about collecting the data?' and 'How will you access the patients or the research subjects?' were conducive to the learners' autonomy, making them further elaborate on elements of their research proposal in a self-regulated and reflective way.

However, in contrast to the perception of Facebook as a peer-to-peer medium, there were limited peer interactions – particularly when the interaction involved being critical towards others' research conceptions. This happened although the supervisor had encouraged peer interaction from the onset, as the following statement implies: 'Any comments from the other students? What are some of your thoughts on the suggested topics in terms of researchability and feasibility?' This supervisor's call for critical peer feedback was left unanswered by the group.

In addition, the embedded technological structuring of Facebook postings did little to support the recursive, multilevel development of critical arguments. Facebook only afforded one structural level of question and answers. That is, in contrast to the typically multilevel threaded discussions in forums, postings could only receive one level of comments that were added chronologically. This mechanism prevented the development and visualisation of deeper, mutually referring and ramified levels of discussion in one original posting. In the absence of threading and linking features, the interlocutors were required to use identifiers in the form of textual anchors to mark and connect the individual contributions of the teams. This could be identifiers in the form of numbers ('Change 2[!]. to identify') or the geographic areas of the teams ('D Site again.we have […]').

Relationship development and emotional proximity

In addition to intellectual support, relationship development is conceived to be another central pillar of supervision. In e-supervision the development of personal relationships is considered to be particularly relevant, but also especially challenging owing to the lack of co-presence needed to facilitate the establishment of trust (Pachler & Redondo, 2012). Initially, considerable social distance was observed in the group. That is, most of the discussions had an intellectual orientation and a limited number of socio-emotional conversations could be observed. This was because many learners had not met the supervisor before and could not build on trust and proximity developed in previous, face-to-face relationships. And, although the supervisor personally greeted and welcomed individual members of the teams, intimacy and friendship were not promoted from the beginning. Conversely, in one of the first postings the supervisor marked the space explicitly as a means for 'research-related discussions, not personal discussions'. This was done with the goal to emphasise the formal educational use of a platform that was mainly perceived as a social, private and non-educational space.

However, soon after the start, the learners and supervisor started to construe an increasingly social community. They built relationships and created and maintained a socio-emotional presence in the Facebook group. A considerable number of the messages had a motivational and affective character. The intimacy that developed over time was particularly evident towards the end, for example, in one of the last postings after the submission deadline, after which some conversations continued:

> Supervisor: I miss our daily chats :-)
>
> Student 1: […].... we miss u too
>
> Student 2: we miss u 2 u too …. Well after examz we will back

The sociality and intimacy of the space was also created through the continuity of the stream of discussions that went far beyond typical 'office hours'. It extended into originally private 'time zones', such as evenings and weekends, blurring educational and personal boundaries. This culminated in a specific form of closeness and privateness which was explicitly acknowledged and can be nicely seen in the next statement:

> Supervisor: Thanks for all the chatting today. I'm off to bed […] Goodnight
>
> Student: Thank u very much A [supervisor] u hav given us a lot and we were realy [*sic*] clueless. God bless u and hv a happy Sunday

In addition, a structural mechanism of the social media space inextricably intertwined the private and the professional, producing a multifaceted, multimodal ensemble. Users' profile images were taken from their personal profile sites, showing some of them in very personal contexts, such as with their

partners or friends. These were directly tied to their postings that harboured primarily intellectual and research-oriented discussions. In this way, aspects of the participants' personal lives were directly connected with professional and educational discourse. Through this mechanism, wider political and cultural notions were also brought into the social media space. For example, at a time when the former South African leader Nelson Mandela was critically ill and in hospital, one user showed her identification with him by using his portrait as her profile image, constructing and sharing the online representation of herself through his image.

Theoretical and practical discussions

Prima facie, the concepts from Lee's (2008) theoretical framework could be identified in the written discourse between the supervisor and learners. In particular, the indicators of functional supervision and critical thinking were in evidence. This reflected the demands of the relatively close guidance of learners in the early stages of their research trajectory. Upon a closer (or, actually, a wider) look, it can be seen, however, that supervision and learning were not exclusively products of the written interactions. Instead, these processes were afforded and constrained by the complex interplay of the inherent technological, functional and multimodal, as well as the wider sociocultural, political and sociolinguistic structures of the space (see Table 1 for an overview).

The provision of direction and functional guidance, for example, was inhibited by the sequencing algorithm of the postings in the Facebook group that prioritised novelty at the expense of continuity and reviewability. Functionalities that applaud recentness are typical for a space that needs to constantly attract the users' attention to marketise. However, as shown, this prioritisation gives rise to an incoherent sequencing of messages, resulting in coordination and uptake costs and restricting the opportunities for grounding (Clark & Brennan, 1991). From an educational perspective, the construction of the reading paths featured rather transient, point-to-point learning episodes instead of a continuum of well-connected learning sequences and the construction of an enduring record of the supervisor's interactions, as foregrounded by Sussex (2008). In that sense, while Facebook groups are certainly spaces for larger groups to engage in ad hoc socialising and networking activities, their capacity to facilitate deep and structured peer learning, particularly for multiple teams, can be seen as restricted.

In the group, students' enculturation in a research community was explicitly tied to the acquisition of a distinctive, formal language. Many of the discursive episodes between supervisor and learners were centred on adapting conceptions so that they would meet the linguistic expectations of what was considered to be appropriate in the domain of research. However, this linguistic trajectory can be seen to be challenged, not only by the fact that English was not the learners' first language, but also by the use of spaces and technologies that typically afford forms of language which are far from compatible with classic, research language. For example, Eisenstein (2013) noted that language use in social media tends to defy even basic expectations about vocabulary, spelling and syntax. Potentially incompatible styles of writing are further facilitated by the convergence of social and mobile media. In the study, a large part of the contributions were made from mobile phones – portable technical devices that feature distinct input affordances and attendant, non-standard forms of expression (Gouws, Metzler, Cai, & Hovy, 2011; Thurlow & Brown, 2003). In essence, enculturation as a linguistic developmental process needs to be negotiated against the dominant sociolinguistic structures facilitated by the social and mobile media spaces in use.

In the conversations studied, the supervisor encouraged critical thinking and the development of criticality. While the supervisor's impetus gave rise to the reflective engagement of learners with their own conceptions of research, hardly any criticality was observed in the interactions between learners, despite the supervisor calling for this kind of feedback. This reluctance can be attributed to the limited experience of the learners in research and to their lack of self-confidence and perhaps also to the resistance to critical feedback among peers. In addition, the absence of peer criticality can also be seen as a product of the embedded technological structures that applaud commercial imperatives. For example, as Friesen and Lowe (2012) argued, the very nature of Facebook fosters a culture of conviviality and

Table 1. Overview: supervision in the social media space and attendant structural dynamics.

	Supervision function	Supervision in the social media space	Structural dynamics and related concepts
Functional supervision	Supervisor directed students' activities through topical support and meta-direction.	Direction and clarity inhibited by sequencing algorithm that constantly repositioned (older) posts with new comments at the top, resulting in costs of reviewability, transient, point-to-point and 'in situ' learning episodes.	The marketising realities of a corporate social networking company (*economic structures*) favour principles of novelty (that grab the consumer's attention) over more stable/coherent reading paths (*technological-functional structures*).
Enculturation emancipation	Supervisor encouraged students to become legitimate members of a research community by acquiring a distinct language.	Use of two different languages: colloquial idiom for communication about research and a more formal language to state the elements of the research proposal; but both contained means of expression resembling informal 'SMS language'.	Linguistic trajectory challenged by use of personal spaces (social media) and technologies (mobile input devices) that afford colloquial language (*sociolinguistic and technological structures*) (Chaka et al., 2015).
Critical thinking	Supervisor prompted students to problematise and question their own and others' arguments.	Limited criticality observed in the interactions among learners from different teams despite prompts. One level of questions and answers did not allow for the development of ramified levels of discussions.	Criticality softened by mechanisms that applaud a culture of conviviality (*functional/political*) (Friesen & Lowe, 2012); that connect (intellectual) debates to the users' private spheres, e.g. via profile image (*functional-multimodal*); and that are influenced by beliefs regarding the dominant debate (*political, 'spiral of silence'*) (Hampton et al., 2014; Robson, 2015).
Relationship development	Supervisor and learners developed a social community, i.e. they built relationships and created and maintained a socio-emotional presence.	Ongoing stream of discussions blurring educational and personal boundaries. Functional mechanisms intertwined personal information (e.g. profile image) with academic debate.	Merging of personal and intellectual spheres (*functional*) and immediacy and continuity of stream of conversations (*social/temporal structures*) supporting development of intimacy and relationships (telecocooning, e.g. Habuchi, 2005; Timmis, 2012).

'liking', offering only a restricted capacity to facilitate disagreement and controversial debate. This manifests in a myriad of design decisions which are often opaque, such as the ways in which new 'friends' are 'suggested' (on the basis of similarity) or in which items 'liked' by others are displayed in one's own space. A more overt symptom is the absence of a 'dislike' button. They posit that the option to express disagreement, for example with regard to a brand, is contrary to Facebook's business interests (Friesen & Lowe, 2012). Recently, the argument that Facebook inhibits criticality has been substantiated by empirical studies. Hampton et al. (2014) found in their large, survey-based investigation that users did not speak up on Facebook about issues when they believed that their point of view was not widely shared. These dynamics culminated in homogeneity and a 'spiral of silence', stemming from the sociocultural and political structures of the dominant debate in the users' worlds. In addition, Robson (2015) observed that teachers' anonymous discussions in a forum tended to be dominated by open interpersonal conflict, whereas their engagement on Facebook was marked by 'positive affirmation', such as the avoidance of conflict and the reinforcement of others' statements. Robson tied the observed 'interactional positivity' to the functional mechanism of the space that linked the arguments directly to the users' personal profiles, and, in the words of Domingo et al. (2014), created a new 'multimodal ensemble' that blended the private and the academic. In Robson's (2015) study, this inhibited the open and conflicting debate that he observed with forum users who could hide behind their anonymous usernames when critiquing their peers. The same mechanism, however, can be seen to enable intimacy and be a relevant component

of relationship development and maintenance in the supervision processes. In addition, intimacy was facilitated through the ongoing stream of conversations that extended past the professional and educational into private spheres. This reflects Habuchi's (2005) concept of 'telecocooning', which creates a zone of intimacy where people can continuously maintain their relationships without temporal and geographic restrictions. Similar to the observation in this study, Timmis (2012) found in her analysis of students' instant messaging that the temporal synchronicity and continuity of conversations (dropping in and out over a long period of time) produced a cocoon, that is, an empathetic space that maintained the social fabric of the community. Arguably, this dynamic is facilitated by the convergence of mobile and social media, with the use of social networking sites on personal mobile technologies forming a constitutional element of users' everyday sociocultural communication practices. For example, many people use their mobile phone in the morning to access social networking sites before even arising (Ericsson Consumerlab, 2011).

From a more practical viewpoint, it needs to be considered that Facebook, as used in this study, supported a selective part of what prior literature characterised as social media qualities for developing research skills. For example, the platform did not offer viable qualities to present the supervisees' academic achievements to the group or to a wider audience and it did not allow them to sharpen their research profiles (Le, 2012). To support research education more comprehensively, different platforms that showcase research teams' emerging and final products, such as wikis and e-portfolios, could be used in addition to the social media space. Moreover, the tendency of Facebook to inhibit criticality might be counterbalanced by creating distinct pedagogic structures. This could be realised, for example, by making peer evaluation an integrative part of the module and by providing the students with a set of criteria according to which the evaluation has to be carried out in social media space, as it was done, for example, in Aburezeq and Ishtaiwa (2013) on the use of social media for language learners.

However, the use of the Facebook group enabled what De Beer and Mason (2009) observed in their South African study, namely the facilitation of instant learning episodes, location – independent support and the closer connection of students and their supervisor in ways which were not previously possible – a feature that was especially valuable in the rural and remote settings under investigation.

Although this study has established a framework that conceptualises the different ways in which learning and supervision are negotiated in a structured social media space, this work can only be seen as a starting point in the exploration of this subject. The findings have to be interpreted with care and require further research. Firstly, the context was specific (a group of rather inexperienced digital users in South Africa). It remains unclear as to what extent the dynamics observed here would unfold in other settings, for example with more experienced users and more mature researchers, or in different social media spaces. Secondly, from a methodological viewpoint, future work may strengthen (or extend) the results of this research by adding more nuanced (qualitative) perspectives gained from interviewing users of the space or by quantitatively evaluating the patterns discerned. And thirdly, social media and associated structures are by no means stable entities: they are subject to constant change. This involves, for example, the ever-extending functional repertoire of social media spaces and also the changing political and sociocultural dynamics. Accordingly, this work can only be deemed to be a snapshot in time.

Conclusion

Drawing on empirical episodes from the discourse in a social media space, this research has conceptualised the distinct ways in which learning and supervision is scaffolded and inhibited by the embedded and wider structural dispositions of a social media space in a myriad of complex ways. More precisely, the concepts of research supervision borrowed from Lee's (2008) framework (functional supervision, enculturation and emancipation, critical thinking and relationship development) do not result from learner/supervisor interaction in a neutral sphere. Instead, they are shaped by the interplay of inherent technological-functional and multimodal – as well as wider sociocultural, political and sociolinguistic – structures associated with the social media site.

Importantly, this study should not be mistaken as applauding structural determinism, where the inherent and wider structures of the space enforce a distinct demeanour on the learners and supervisors. Instead, the article's main contribution should be seen in its analytical disentangling of how learners and supervisors have to negotiate the tensions that arise from these structures as they exercise agency in their attempts to achieve learning and supervision in social media spaces.

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No potential conflict of interest was reported by the authors.

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Informal mobile learning in nurse education and practice in remote areas—A case study from rural South Africa

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SUMMARY

Background: With the proliferation of portable digital technology, mobile learning is becoming increasingly popular in nursing education and practice. Most of the research in this field has been concentrated on small-scale projects in high income countries. Very little is known about the ways in which nurses and midwives use mobile technology in remote and resource poor areas in informal learning contexts in low and middle income countries.
Objectives: To address this gap, this study investigates whether nurses use mobile phones as effective educational tools in marginalized and remote areas, and if so, how and why.
Setting and Methods: In rural South Africa, 16 nurses who attended an advanced midwifery education program, facilitators and clinical managers were interviewed about their use of digital mobile technology for learning. Techniques of qualitative content analysis were used to examine the data.
Results: Several rich "organically-grown", learning practices were identified: mobile phone usage facilitated (1) authentic problem solving; (2) reflective practice; (3) emotional support and belongingness; (4) the realization of unpredictable teaching situations; and (5) life-long learning.
Conclusions: It is concluded that mobile phones, and the convergence of mobile phones and social media, in particular, change learning environments. In addition, these tools are suitable to connect learners and learning distributed in marginalized areas. Finally, a few suggestions are made about how these insights from informal settings can inform the development of more systematic mobile learning formats.

Introduction

Mobile Phones and Nursing Education

Mobile phones and smartphones are increasingly popular in nursing education and practice (Garrett and Klein, 2008). They support a broad range of educational practices in formal education settings as well as in clinical environments (George et al., 2010). For example, the use of smartphones by Taiwanese nursing students as clinical examination tools in simulations proved to result in higher learning outcomes compared to a control group who used pen and paper to record and evaluate patient symptoms (Wu et al., 2011). In a British study, multimedia podcasts on iPods were used directly at the bedside to support the learning of midwives regarding the Newborn Infant Physical Examination (Clay, 2011). The analysis of the small-scale pilot revealed that the tool was well received and the participants specifically appreciated the "just-in-time" learning facilitated by these devices. Similarly, studies from the US and Canada come to the conclusion that nurses and nursing students view mobile devices as effective means to support their learning in the workplace by enabling access to various sources of expertise in decision making processes. Reference tools such as drug and diagnostic/laboratory applications were found to be particularly popular and valued (Garrett and Klein, 2008; George et al., 2010; Kenny et al., 2009).

In addition to the provision of information and communication features, a mobile e-portfolio allowed Canadian students to document their clinical experiences using different modes including text, audio and image. The students greatly valued the reference functions, but also appreciated the opportunity to capture clinical events in the form of photographs (Garrett and Jackson, 2006). The study also referred to the potential of mobile connectivity to prevent isolation in clinical placements. Young et al. (2010) specifically examined this aspect and found that UK nursing students used the texting facility of their own mobile phones as an additional support mechanism to interact with peers and mentors while working in placements. Their findings showed that

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even those students who did not use this facility appreciated it as a potential means of contact when feeling isolated in the clinical placement. Similarly, in another UK study reported by Morley (2013), digital technology was used to support learning in clinical placements and to address professional isolation whereby a range of Web 2.0 tools was piloted to support peer and learner–tutor interactions of nursing students working in isolated placements settings. One of the most popular tools was a Facebook group with high levels of learning interactions. Although the author provides no details, it is noted that students increasingly access this social network site by means of their mobile phones. Mobile phones as educational tools in resource limited settings.

What most of the literature has in common is that the studies were conducted in high income contexts, predominantly in Europe, the US and Australia. Very little is known about the ways in which nurses and midwives use mobile technology in remote and resource poor areas in informal learning contexts in low and middle income countries.

In these countries nurses and midwives have an important role for the delivery of health services and they are considered to be the backbone of the health systems due to a lack of other qualified health professionals (Green, 2006). However, these nurses are often professionally isolated and receive little support and training; many leave the profession or migrate to high income countries (Raisler and Cohn, 2005).

Against this background, international organizations such as UNICEF, ITU and the World Bank have developed high expectations towards mobile phones to support and empower health workers, including nurses and midwives. This is specifically relevant in the context of the Millennium Development Goals, regarding mother and child health and HIV/AIDS. (Holmes, 2010; ITU Press Release, 2010; The World Bank, 2012). However, little is known how mobile devices are being used to support nurses in their learning practices. In an article discussing information technology for nurses, the use of mobile technology is seen as a great opportunity, specifically in Africa. Information and communication technologies in general were deemed as a possible means to address some of the factors to out-migration, such as isolation and lack of educational opportunities (Abbott and Coenen, 2008).

Methodology

Research Question and Sampling

In light of the expectations and gaps identified in the literature, the following research question was defined:

> *Do nurses in disadvantaged and remote areas use mobile phones as effective educational tools, and if so, how?*

Addressing aspects of maternal and child health, this study was centered primarily on nurses who attended an advanced midwifery education program in rural and disadvantaged areas in a province of South Africa. In contrast to other provinces in South Africa, this setting can be characterized by a high percentage of people living below the poverty line, high infant and adult mortality (Coovadia et al., 2009). Nurses in these settings often work in isolation and have very poor access to post-basic education, continuing education and up-to-date evidence-based information. In order to access education, these nurses are expected to travel far distances away from their place of work and home.

In selecting the people and roles typically involved in nursing/midwifery practice and education, we used typical case sampling (Patton, 1990). To cover a broad range of potential learning practices related to formal education as well as informal workplace learning, nurses in the following roles were involved: (1a) eight registered nurses in formal education settings who attend a decentralized education program for advanced midwifery at a University in South Africa; (1b) these participants worked at the same time as registered professional nurses in clinical settings; (2) four nurse facilitators, who support the midwifery students in crossing the boundaries between the formal education program and their work; and (3) three nurse managers, who have an overview of work, learning practices and needs of nurses in their clinics. To involve the managers, we visited three sites that represented typical health service centers of rural South Africa. We approached nursing students and facilitators when they gathered for a lecture at the university. In addition, video interviews were conducted using the university's videoconferencing system.

Data Collection

After obtaining ethical approval from the University, the research team visited three rural sites to interview the participants. Between June and August 2012, 16 participants were interviewed. Before each interview, it was ensured that all interviewees participated voluntarily. In addition, the confidentiality of the participants was ensured and written informed consent was obtained from every participant. All of the participants allowed the conversations to be tape-recorded.

For the semi-structured interviews, an initial question guide was prepared that comprised questions on learning practices in work and university settings, with a specific focus on mobile phone usage and perceived implications.

Data Analysis

All interviews were audio-taped, transcribed, and analyzed using the software Nvivo Version 8 (QSR International Pty Ltd, Doncaster, Vic, Australia). The analyses followed the principles of inductive category formation, a technique of qualitative content analysis suggested by Mayring (2000, 2004). According to the research question, the selection criteria and the level of abstraction for the categories were broadly defined as socio-cognitive and socio-cultural forms of learning. This is a scope which, according the mobile learning examples in the introductory literature review, and recent theoretical works (Pachler et al., 2010; Pimmer et al., 2010) is suitable to address the breadth of the educational practices supported by mobile technology. Broadly speaking, socio-cognitive perspectives connect cognitive and constructivist views of learning. Socio-cognitive perspectives emphasize that learning needs to be situated in tasks and problem solving in real-life contexts (Kirschner, 2006). This is of particular relevance for health professions, where much of the learning is routed in the workplace, in the form of authentic and problem-based learning (Norman and Schmidt, 1992; Slotnick, 1999). Socio-cultural learning perspectives are centered on the notion of participation: the main purpose of meaning making and learning is for learners to progress from peripheral to full participation in public and professional life. Lave and Wenger (1991) elaborated their ground breaking theory of community of practice and situated learning using the example of midwives, who 'absorb' skills by participating in communities of practice in resource-poor contexts in Yucatan (Jordan, 1989). Accordingly, the analysis departed from a broad understanding of learning that included work-related learning activities (in particular critical thinking and problem solving) as well as any signs that indicated a participation of an individual in a community of learners and practitioners.

The design, analysis and interpretation were jointly conducted by researchers from nursing/medical sciences and social and educational researchers to prevent researcher and disciplinary bias (Pope et al., 2000). The principal investigator (CP) coded all of the transcripts. Two researchers independently read, re-read and interpreted approximately 25% of the data. The findings were critically discussed by all authors until consensus was achieved. For respondent validation (Mays and Pope, 2000), the interviews were re-conducted with three participants, one facilitator and two students. The preliminary findings were presented to the interviewees and were validated by them.

Results

The analysis yielded five main themes, i.e. learning practices, which are presented below:

Authentic Problem Solving

The use of mobile phones enabled and supported learning throughout patient related problem solving processes. This was often prompted by a patient case that was outside the learners' competencies. For example, the participants indicated that they used their mobile phones to involve various virtual communities in "on-site" problem-solving processes. In doing so, they created a mobile and blended learning environment. One facilitator described how students accessed Facebook communities to ask for support from their peers in these situations:

> *"They do it on Facebook, and they have a group, or [..] they start to ask their friends there […] Like someone will ask how to go about, if you are having a client who is having this and this problem and someone else is going to answer. That is how you better check this and do one, two, three. Thus, getting a solution."*

These communities were fragmented in geographical and virtual spaces. Midwifery students lived in different and under-sourced areas and worked in diverse hospitals. In the case of immediate and urgent questions, students tended to use synchronous communication functions to connect with their virtual communities and would contact one of their facilitators by chatting, texting or phoning. One facilitator described a situation in which she had been consulted by means of a (synchronous) phone call:

> *"The one [*midwifery student*] was having a breech delivery [in a remote clinic …]. That is a complicated case. […] Then I asked, what do you think? She said, I am thinking this one is complicated, it needs to be done caesarean. […. I asked:] Have you checked whether the woman is fully dilated or not? Because if she is fully dilated you cannot send her thirty kilometers by ambulance or by her car. […] if she is fully dilated, she is about to deliver. Let her deliver in your hands in the clinic."*

Although there were also formal ways of consulting doctors in work-based settings, participants valued phone-based problem solving because of the immediate access to resources and rapid feedback from their virtual communities. Communication in the case illustrated above included weighing and discussing options and lasted until an initial solution was found. Thus, it had a direct impact on patient management: the patient remained in the remote clinic due to certain health conditions. The knowledge was co-constructed in that the midwifery student strongly contributed to solving the case. In doing so, the facilitator deliberately guided and directed the student. The above excerpts also reveal how learners used mobile phones to virtually link formal education systems (facilitators) to clinical processes, thereby connecting education and work communities.

In addition to involving virtual communities in inquiry processes, many participants indicated that they searched for relevant online information to support inquiry processes in both work-based and course settings by using the search engine, Google, on their mobile phones. A nursing student explained how this practice contributed to her situated understanding and meaning making:

> *"I was working in the ICU […]. Consultants […] said the child had PPHN, and I was not familiar with the term, […] so I had to look it up for myself, to see in relation to the treatment what the child was getting and what was the cause of all this. I think that was quite useful because then I […] had a clear picture immediately. […] It was there, the information was there at that moment. […] I could actually share the information I had with my colleagues."*

Reflective Practice

The excerpt above also revealed another important concept: sharing information at a later point in time with colleagues in virtual spaces as well as with on-site colleagues by showing them the information on the phone. Mobile phones facilitated and mediated group discussion and reflection. Some participants reported using their mobile phones in diverse ways to document and/or share, discuss and reflect on professional experiences in communities. Students and facilitators described how they occasionally used phones to document work experiences in the form of photographs and shared them in the classroom at a later time.

> *"When we are together [in school settings], we share and discuss the photos. Some [conditions] we learn in school take a long time to see [in practice settings]. So, when you witness this condition and you are not together with your colleagues, you take this picture. […] Then you look at the picture and [later] discuss it, if it corresponds with what we have learned." (Nursing student).*

The two previous empirical extracts show how multimodal representations (text and images) facilitated the connection of situated learning across different communities over time and, in the second example, also across geographical space. This example also illustrates how phones mediate and iteratively connect learning in work and formal education settings. The participants also involved (exclusively) virtual communities on social network sites in their reflective processes. One participant reported using Facebook to asynchronously discuss and reflect on professional experiences. She provided the example of a closed Facebook alumni group that was formed several years ago by students from her basic nursing education. These students had specialized in various areas of nursing and worked in different geographic regions. Using a Facebook group, the nurses consulted each other through straightforward and supportive feedback in addressing, for example, unexpected interdisciplinary patient cases, situations in which knowledge from different nursing specializations needed to be combined, or practices that a student viewed as beneficial to patient treatment as well as to her own competence development.

> *"Sometimes you use the group afterwards, after you have managed the patient, to see how you went, where you went wrong, how you did, or sometimes they say I messed up. Then, they give you the reasons, or sometimes they will tell you, oh, well done, but you missed that and that."*

Emotional Support and Belongingness

Beyond the solving of factual, clinical problems, a number of emotional and social communication practices were observed regarding the use of mobile phones. Mobile interaction often involved emotions, such as when midwifery students were "anxious" and then spontaneously activated their communities and other resources for help. The next extract shows that, mobile phone-based emotional support was provided that went far beyond clinical problem solving:

> *Interviewer: "Do you exchange SMS with your teachers [facilitators]? Nursing student: Yeah, she is like a mother to us, we do. […] Yeah, even like a family problem, personal problem, we do talk to her."*

This statement also demonstrates how learners connect formal education, work and private spaces by means of mobile technology. They discussed details of their lives outside of the course and work setting with facilitators, i.e. beyond their peer milieus.

However, although openness and trust were central aspects in the above example of the Facebook group, participants tied honest and straightforward feedback to the peer characteristics and the non-hierarchical structure of the group. They reported using informal

language that would not be appropriate with facilitators (who evaluated students). There were concerns that their peers would not willingly report and provide feedback on patient treatment if staff from the formal education system were participating in these groups:

"Others might not tell me straight, a fair answer, because they will know she [facilitator] is also part of the group."

This supports the view that mobile phone usage resulted in the creation of new patterns of media (and related language) use according to the specific microculture; a culture which was, however, different from those of formal education institutions. The observation that students established and engaged in social "mobile" groups in a bottom-up manner points to the cohesive nature of these spaces and to an associated sense of *belongingness*. In characterizing these spaces participants used inclusive pronouns ("we") and referred to these groups as spaces to which to which they belong:

"Yes, ***we*** *formed a group,* ***we*** *have defined groups.* ***I belong to the group*** *[…]"*

Realization of Unpredictable Teaching Situations

Learning situations in both the workplace and, to some extent, in the formal educational program are hard to predict as they are shaped by the nature of the problem (e.g., patient cases) as well as by the dynamic environment in which they occur. In this context, mobile phones provide flexibility in arranging and realizing learning situations, particularly regarding formal educational settings: for example, facilitators communicated new or spontaneously changed schedules for lectures by means of their phones to the students:

"[…] For instance, for today, she [facilitator] had to SMS us because we are on leave to let us know that there will be a lecture." (Nursing student)

Outside of formal classroom settings, students spontaneously involved facilitators in particularly interesting patient cases in the clinic by means of their mobiles. Thus, mobile phones facilitated the realization of unpredictable on-site teaching in ways that were not previously possible (and, again, connected formal education and work-based settings more closely).

"[…] We would phone and tell her that […]maybe if she is close by, she will come around. […] Then, she will teach us in the real situation, not like we are doing a theory in class." (Nursing student)

Mobile phones were not only used to harness unforeseen opportunities, but also to address challenges in the organization of teaching events that were caused by external dynamics.

.. When I came to town, there were riots, people, the taxis were not working then, they had been stopped. So I phoned one of my colleagues who was already at school to fetch me. " (Nursing student)

Life-long Learning

On a general level, the mobile phone was the most important computational tool for the interviewees. Their use was reported to be a widespread and popular practice, not only within the interviewed sample, but also in the wider nursing community, as expressed by one participant: *"Not a single nurse without a mobile phone" (16)*. Nearly all of the participants used their phones on a daily basis. All of them regularly accessed internet-based applications on their phones, mostly to search for information and for social purposes using text messages, chat or social media. However, the intensity and scope of mobile phone use was linked to age; the participants often reported that younger midwives used mobile phones more broadly and frequently for private, work or learning purposes.

The participants indicated receiving no support from educational or other institutions, such as hospitals, in the use of mobile phones. Moreover, in many places, the use of phones was actually discouraged, as expressed by a nursing manager:

"It's one thing that I do not like to see when I go to the wards. I don't like to see people carrying phones."

In spite of this, however, midwifery students mutually helped each other with the new opportunities provided by mobile technologies. More importantly, many of them reported being encouraged and supported in the use of mobile phones by the younger generation, particularly their children:

"Actually, I was shown by my daughter at home. […] So I showed my colleagues, yeah." (Nursing student)

The use of these phone functions empowered nurses in a sense that they were provided with more, and more diverse options to participate and engage in social spaces (e.g. religious communities on social networking sites) and to access opportunities for learning not previously possible (e.g. by using mobile internet to search for new posts). Accordingly, the phone has become a central tool for their life, and their life-long learning:

"*It is part of my life now […] a means of contact, a means of learning. You know, people who have phones just learn a lot." (Nursing student)*

The centrality of mobile was also evident from a bodily perspective. Participants often carried their phone in their brassiere, a place where people in South Africa store and hide things that are valuable to them (Seedat, 2006).

Discussion

The results have a number of conceptual and practical implications. We characterize on the basis of didactic parameters how the mobile phone usage observed can be conceptualized in terms of learning environments; make recommendations for practical improvements including ethical issues; and present options for further research.

Rich Mobile Learning Practices

It has become evident that mobile devices have a specific potential to support socio-cognitive learning processes in the form of problem-solving and reflection in the workplace. (George et al., 2010; Pimmer and Pachler, 2013). Work-based learning as observed was not restricted to accessing information at the point of care. Social communication functions and apps allowed peer-to-peer co-construction and exchange of local knowledge and emotional support; practices that are closely tied to and affect work processes and patient treatment. Viewed in terms of socio-cultural participation, nurses used their mobile phones to more intensively engage in various social/professional communities in ways that were not possible without mobile technology. In this sense, mobile phones, and in particular the convergence of mobile and social media, can support learners in alleviating professional isolation, as it was also indicated in the literature (Morley, 2013; Young et al., 2010). These findings are also in line with other studies from low resource settings showing how mobile phones support socio-cultural participation and identity formation (Pimmer et al., 2012, 2013a) and enhance professional relationships (Chib, 2010).

The Changed Meaning of Learning Environments

The identified learning practices such as problem-solving, reflection, emotional support and belongingness to (virtual) social groups, or the use of digital technology for teaching and life-long learning could be

discussed in light of a number of specific pedagogical concepts. Putting it in the words of Laurillard (2009), mobile technology has not changed "what it takes to learn". What has changed, however, is the meaning and characteristics of learning environments. In the following, we use a number of educational parameters to distill our findings with respect to learning environments: space, degree of formality, tool, synchronicity, prompt, modality, predictability and time span (see Table 1).

The implications of mobile technologies on the characteristics of learning communities are most evident. According to Lave and Wenger (1991) the main way of learning is for a learner to progress from a novice to an "old timer" in a community of practice, for example, a group of midwives. In the field of technology-enhanced learning, Garrison et al. (1999) widely popular community of inquiry framework has also primarily been used to study learning in bounded digital spaces, for example in courses in learning management systems (Mayne and Wu, 2011); a focus on learning that, in addition, tended to be teacher-guided using asynchronous, text-based communication.

We found that learning, as observed, is not restricted any longer to tightly bounded and locally based communities (of practice) or to closed online communities (of inquiry). Nurses in low resource areas use mobile phone functions, particularly social applications, to dynamically connect learning that is distributed in mobile and blended communities across different geographical, social, temporal, and topical as well as virtual and on-site spaces. The examples have shown that nurses used these devices to connect learning in formal education systems, i.e. in the context of the course, with learning in informal learning settings, i.e. the workplace. In this sense, mobile phones can be perceived as boundary crossing tools, as they embed fragmented communities and other knowledge resources in learning processes and, in so doing, they connect nurses working in professional isolation. In the contexts observed in this paper, nurses flexibly used a bundle of different tools, including synchronous and asynchronous communication functions according to situated work and study needs.

Mobile learning was not pre-determined by the teacher, but problem-driven, shaped, and guided by the nature of the problem. In addition, in the educational and work-related use of the mobile phone the learners were not formally supported by education and work institutions, but by their peers and their own children. The participants' learning processes involved multimodal design, including linguistic, audio and visual meanings (see e.g. Cazden et al., 1996). In the settings explored here, relatively stable and predictable learning processes were found in on-site communities such as co-present work and study teams. By contrast, nurses used mobile phones to organize and support learning to better address unforeseen and unpredictable occurrences, characteristics that are typical of clinical settings in general (Pimmer et al., 2013b) and particularly in the changing macro- and socioeconomic health contexts in South Africa (Coovadia et al., 2009). In addition, nurses used mobile phones to connect situated experiences with sources and communities, even across phases of their career trajectories in the sense of life-long learning (Pimmer et al., 2013a).

Practical Implications, Ethical Issues and Recommendations

Our results from informal, work-related learning settings resonate with some of the findings in the extant literature from US and European contexts, and more formalized and planned education interventions. However, we deem the value of this technology to be even higher in lower income countries because the mobile phone is often the only computational tool available for accessing additional knowledge. It can alleviate professional isolation, which is a much more dramatic problem in developing countries (WHO, 2010), and it also helps learners to respond more flexibly to unpredictable learning situations in dynamic and transforming contexts. As indicated, mobile phones seem to be valuable for connecting school-based education and workplace learning, such as in the form of virtual tutorial support in the workplace or reflective practice.

However, the use of mobile technology does not result in positive effects per se, and brings a number of ethical and practical issues to the fore. These challenges relate to the development and maintenance of professionalism, safe practices, and to the protection of patient privacy in these new media spaces. Responding to these issues, mobile and social media should not be banned or ignored in education and work-related settings, as we observed in this study. It can be even argued that thorough restrictions on the nurses' use of digital media are not feasible and practical. Instead, nurses should be educated and supported in the systematic development of a broad set of health- and media literacy skills which include the access, analysis evaluation and creation (sharing) of content (Livingstone, 2004). These themes should be integrated into national medical/nursing/midwifery curricula and other training formats. For example, the creation and sharing of patient-related information across mobile and social media spaces are a highly sensitive topic, specifically when it comes to the exchange of photos. Taking patient photos with (phone) cameras for learning, teaching or joint problem solving represents an indirect therapeutic function (Berle, 2008). Thus, nurses, and other health professionals, should be trained to ask for written consent before taking such a photo, even if it is not identifiable (Bhangoo et al., 2005). This is all the more important because the use of mobile phones and social media is associated with personal and not with professional communication. It is, typically, not perceived as a clinical activity and could be viewed as an invasion of privacy by the patient. Thus, the provision of explicit information and clarification about the purpose of the phone-based activity of the patient is necessary.

Key is also the learners' literacy with respect to the critical analysis and evaluation of content. In this regard, responsibility is shifted from the teacher to the learner, because instructors cannot control and be

Table 1
Connected learning in distributed environments.

Learning environments	Characteristics	Examples
Space	Multiple communities, "mobile" and blended, distributed in social, temporal, topical, geographical, digital and on-site spaces	Work colleagues, study colleagues, former work/study colleagues living and working in different sites
Degree of formality	Link learning in formal education systems with learning in informal work settings	Sharing learning experiences at work with peers from work, the course and lecturers; involving facilitators (from the course) in work process by means of mobile phones.
Tool	Boundary crossing tool	Use of call, text, WhatsApp, Facebook to link different sources to problem solving and learning processes across different spaces
Synchronicity	Synchronous and asynchronous	Chat or talk with facilitators and peers, depending on the urgency of a questions/problem
Prompt	Problem-driven, bottom up, peer-peer, according to situated needs	A more complex or "rare" patient case. Changes in the educational environment that effect the teaching organization.
Modality	Multimodal: text, voice, images	Discussing "mobile" images across on-site communities
Predictability, stability	Dynamic, unexpected	Ad-hoc phone-based support, triggered by a more complex patient case, or an unexpected occurrence.
Time span	Connecting situational *and* life-long learning	Reflecting upon a documented patient case with former students

involved in all the different media formats and spheres available today. Nursing students need to learn which social and digital sources to trust, how to evaluate trustworthiness, and to be aware of their own boundaries and limitations. However, professionalism within (social) media is not something that can be trained top down exclusively. Instead, teachers and facilitators could co-create social media spaces with their students. In these safe environments, they could trigger students to think reflexively and critically about their own professional experiences, their online personae and their professional online behavior, as suggested by Brown (2010). Learning in these "laboratories" is not characterized by direct instruction, but by enculturation: by teachers and facilitators who model appropriate and sensitive behavior. An additional means to ensure professional behavior is also through the development of guidelines. Berle (2008) suggested the integration of a code of ethics for clinical photography in codes of practice. This approach might well be extended to the general use of mobile and social media in clinical environments.

In view of limitations of mobile communication discussed, and given the embodiment of knowledge and skill development in nursing and medical practice (Jordan, 1989; Pimmer et al., 2013c), it should be clear that mobile learning for nurses and other health professionals cannot be considered a (cheap) substitute but should be viewed as a complementary approach to formal on-site education systems.

Strengths, Weaknesses and Suggestions for Future Work

The findings of this research were strengthened by a process of independent coding by three researchers from social and nursing sciences, by using the technique of respondent validation and by contrasting the data with existing social science theories (Giacomini and Cook, 2000; Mays and Pope, 2000). Due to the limited scope of this research, we are not able to offer definite accounts of the phenomenon at hand.

Given the methodological limitations of the present work, future studies should (1a) quantitatively measure the impact of mobile learning on professional isolation, problem-solving abilities and patient treatment, including its impact on health; and (1b) further explore and refine learning/teaching methods (such as scaffolding and PBL) based on mobile social media. Future work may also (2) observe different target groups (e.g., younger nurses in basic education, doctors, and community health workers); and (3) explore the phenomenon in other cultural, geographical and socio-economic settings.

From a theoretical standpoint, we argue that more analytical attention should be paid to the transformed learning environments and the affordances that mobile phones offer as tools in connecting multiple on- and offline communities and knowledge resources in problem solving and learning processes. This is not limited to resource-constrained regions, but it may well apply to "Western" systems such as the UK's National Health Service, in which learning in communities has recently been characterized by increased individualization, as well as geographical, hierarchical, and administrative distance (Spilg et al., 2012).

Conclusions

This investigation has shown that nursing students in resource poor settings use mobile technology as educational tools. These learning practices involve socio-cognitive processes, i.e., learning in the form of joint problem solving and reflection, as well as more intensive forms of socio-cultural participation in distributed, education and work-related communities. In order for educational institutions to more fully and more systematically harness the potentialities of these media, a number of ethical and practical issues need to be addressed.

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