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Mobile learning as boundary crossing. An alternative route to technology-enhanced learning?

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This paper examines digital and mobile learning that goes beyond bounded communities and closed domains. While recent work from the field of mobile learning has emphasised the importance of learning across "contexts", little analytical attention has been paid to the underlying dynamics of this phenomenon. To illuminate this, the four learning mechanisms of identification, coordination, reflection and transformation from the framework of boundary crossing are linked with mobile learning practices. It is argued that mobile phones and specifically mobile social media serve as boundary crossing tools: tools that are used by learners to generate multimodal representations that reflect their experiences and identities, and to share them across their digital and non-digital social networks. The four learning mechanisms are facilitated by the learners' engagement with more heterogeneous and peripheral spaces of their social networks in ways not previously possible.

Keywords: boundary; mobile learning; ubiquitous learning; social media; social network sites; informal learning

Introduction

To illuminate the role of digital and mobile technology for learning beyond bounded communities and closed domains such as the classroom, I proceed as follows: I begin by introducing the meaning of "learning across contexts" for the field of mobile learning as well as the framework of boundary crossing. In the second part, I link mobile learning practices to four central learning mechanisms of this framework. Drawing on this analysis, I then establish the notion of mobile technology, and specifically mobile social media, as boundary crossing tools. Since mobile technology has been used to facilitate learning across (more) diverse and more peripheral network spaces, I tie my arguments to the concepts of social capital and weak ties. Finally, I discuss the role of boundary crossing in the light of socioeconomic transformations, crises and weakening educational structures. The underlying rationale of this work is to bring alternative perspectives into the field of technology-enhanced learning; a domain that tends to conceptualize and analyse learning from technology deterministic viewpoints (Selwyn, 2012) and has primarily focused on activities in bounded spaces, such as the classroom (Greenhow, Robelia, & Hughes, 2009).

Mobile Learning as learning across contexts

The meaning of learning and contexts has been stressed specifically in recent mobile

learning research, an increasingly popular strand of the technology-enhanced learning literature. Learning with mobile devices is tied to fundamentally shifting characteristics of knowing and learning as remarked by Traxler and Lally (in this volume), because it provides a wide spectrum of learners (and users) with the opportunities to create, convey, share and collect messages, ideas, and experiences specific to as well as across different settings. The field of mobile learning has even considered the crossing of contexts as one of its constitutional characteristics. Following the definition of Sharples et al. (2007), mobile learning is conceived as "the processes of coming to know … across multiple contexts among people and personal interactive technologies". Drawing on this definition, The London Mobile Learning Group (2010) stresses the dynamic nature of contexts by defining mobile learning as operating "in, and across, new and ever changing contexts and learning spaces". Also Wali et al. (2008) see the core of mobile learning as what they define as context-crossing, referring to a change of physical and/or social setting. This mobility across physical and social spaces is also proposed by Kukulska-Hulme et al. (2010) to be central to mobile learning. In addition, they base their conception of mobile learning on the mobility of technology (tools and resources carried around), on mobility in conceptual spaces (different topics and themes that compete for a learner's attention), and on learning that is dispersed over time. Kukulska-Hulme et al. (2010) view context as an overarching concept of these different mobilities. There are a number of further works that tie together notions of context and mobile learning. However, what many of these have in common is that relatively little attention is paid to the underlying mechanisms of cross-contextual learning, i.e. to the question how the bridging and merging of context(s) actually facilitates and contributes to learning.

(Mobile) Learning by crossing socio-cultural boundaries

By connecting mobile learning with the theoretical work centred on the notion of boundary crossing I intend to further illuminate this aspect. Recently, Akkerman and Bakker (2011) have summarized and conceptualized the rich and increasingly popular literature of learning by crossing "boundaries". They understand boundaries not in a geographical sense but as sociocultural differences that result in discontinuities in action and interaction. Drawing on Suchman (1994), they consider boundary crossing as a person’s transitions and interactions across sites that differ in terms of socio-cultural characteristics. Another related concept is that of boundary objects. Boundary objects are abstract or concrete artefacts (for example teaching portfolios and school grades) that do the crossing by fulfilling a bridging function (Akkerman & Bakker, 2011; Star, 1989).

Accordingly, while context is viewed as a broad and manifold construct, the theoretical framework of boundary crossing can be specifically helpful in

understanding how mobile learning helps to bridge "contexts" in terms of linking diverse socio-cultural worlds. In the literature on mobile phones and mobile learning surprisingly little explicit reference has been made to this theoretical strand. As one of the few exceptions, Attwell et al. (2009) suggest that the use of the mobile technology allows the development of boundary objects to transcend the physical and virtual worlds. They view them as suitable to interlink academic and formal knowledge with informal, work process knowledge. Beddall-Hill and Raper (2010) investigated the role of PDAs as boundary objects on field trips in a master curriculum. Their analysis revealed that the devices did not display the features of a boundary object as defined by Star (Star, 1989, 2010). Nevertheless they played a constitutive role in the learning processes observed.

Implicitly, however, writers from different disciplines such as education, communication, politics and sociology point to the properties of mobile media to bridge socio-cultural boundaries. With regard to education, Lewin & Luckin (2010) describe, for example, that mobile tablet devices contributed to develop parental engagement, tying together more closely the different socio-cultural spaces of school and home in the UK. The tablet interfaces allowed parents to review what the child had done with the tablet inside and outside school and send/receive a message to the teacher. In a very different project in Indonesia in which midwives were equipped with mobile phones, it was observed that, over time, relationships and learning between different professional communities improved. Concretely, mobile phones enabled doctors and midwives to work together more closely in patient-related problems. One doctor spoke of: "Midwives who call me … because they are having difficulty handling a patient … " The respondent further points to the improved relationships between these professional groups, concluding that today "*we are meant to be partners*." (Chib, 2010). These newly established inter-professional conversations are highly interesting from a learning perspective, although this this has not been examined specifically in this study. With regard to the political dimension, Wasserman (2011) foregrounds that, in Africa, mobile phones allow people to "transgress cultural and social borders and hierarchies in the way they refashion identities and create informal economies and communicative networks". He emphasises that mobile and social media are used to create new spaces and alternative ways of engaging with the state and with politics, for example by sharing political rumours, gossip and jokes. Looking through sociological lenses, Geser (2004) conceives the cell phone as a technology with highly generalized integrative functions. While technology tend to accentuate differences, for example, a motorcycle with regard to gender, he emphasizes that since cell phones are adopted relatively independently of education and family background, they can bridge at least some gaps between different social classes. However, he rightly acknowledges that, since mobile phones can be used differently in any sphere, they may also widen social and cultural divergences.

Boundary mechanism in mobile learning

To better understand how the crossing of context can facilitate learning, I draw on the four main boundary mechanisms of identification, coordination, reflection and transformation recently discerned by Akkerman & Bakker (2011).

> "(a) identification, which is about coming to know what the diverse practices are about in relation to one another; (b) coordination, which is about creating cooperative and routinized exchanges between practices; (c) reflection, which is about expanding one's perspectives on the practices; and, (d) transformation, which is about collaboration and codevelopment of (new) practices" (Akkerman & Bakker, 2011)

While their work provides interesting approaches to understanding learning that takes places at boundaries, they pay little attention to affordances offered by digital mobile technologies. Accordingly, I connect these mechanisms with socio-cognitive and socio-cultural mobile learning practices. In so doing, I take examples from the extant literature as well as from a range of my/our own studies from the field of health and medical education. Health care is an particularly appropriate area for consideration since effective medical services require a number of different boundaries to be bridged: for example, interaction between and within different professions (Barr, Koppel, Reeves, & Hammick, 2005; Pimmer, Pachler, Nierle, & Genewein, 2012), between patients and professionals, novices and experts, and among people drawing from different cultural and linguistic resources (Bezemer, Cope, Kress, & Kneebone, 2011).

Identification

The mechanism of identification describes how boundary crossing results in questioning one's core identity which, in turn, leads to a renewed sense-making of different practices and the reconstruction of identities (Akkerman & Bakker, 2011). Examples in the mobile learning literature show how the use of social mobile media to cross socio-cultural boundaries is related explicitly and implicitly to the negotiation and re-construction of professional identities: in a previous study I observed, for example, how medical students use their mobiles to access virtual professional communities with thousands of students and practitioners from across different nations and cultures (Pimmer, Linxen, & Gröhbiel, 2012). In this mobile social networking space, users explicitly announced and "negotiated" their identity as medical practitioners in the light of questions such as "proud to be in this profession, what about you?", cartoons or jokes that related to the professional self-concept of doctors. They projected, re-constructed and also questioned their own professional identity against

messages from cartoons/jokes (mostly from Western cultures) and against the identity revealed in the comments of the other users mostly from across different Asian countries.

Another study from New Zealand illustrates how bakery apprentices used mobile phones to document important work achievements in the form of photos, videos, voice recordings and text fragments. These represented evidence of their growing and maturing skills as bakers. They shared these representations that related to their maturing professional identity on various social network sites (SNS) with other apprentices, their employers and teachers as well as friends and family (Chan, 2011). The opportunity to showcase their work to wider communities was relevant for the motivation to create these portfolios. In this study, the apprentices used mobile social media to cross boundaries between their work and private spaces in ways not possible before. In addition, the practice enhanced and re-enforced apprentices' self-recognition and self-acceptance of their vocational identity development (Chan, 2011).

Coordination

The second learning mechanism is coordination. With this mechanism centrality is placed on the means, such as mediating artefacts, and procedures that enable efficient cooperation in distributed work. While identification means negotiating and re-constructing identities through boundary crossing, the central aspect of coordination is overcoming boundaries and providing continuity in the movement across different socio-cultural sites (Akkerman & Bakker, 2011). In a number of studies conducted in Swiss hospitals (Pimmer, Pachler, et al., 2012) , I observed how representations in the form of photographs on mobile phones can take a mediating role in the learners' work-trajectories across departmental and intra-disciplinary boundaries. The following extract reflects a situation in what is known as the "morning report" - a daily meeting in which doctors from a team, in this case hand surgeons, meet in order to discuss recent patient cases and to decide on further treatment. In this example a resident in the role of an on-call-doctor describes how the mobile phone supports the discussion and coordination of patient cases that were treated beforehand in another department:

> A standard situation with respect to cases from the emergency department is: "I've seen this one [patient] in the emergency department. Here is the photograph" […] Some simply have a smartphone with them. It is placed on the table and passed around. […]. If there is a picture […] on the smartphone, it is passed around in a circle, […] all the way to the head physician, so he can see it. […] The picture is looked at briefly and commented on. (resident)

Generally speaking, on-call doctors are typical "boundary brokers", supporting the

different hospital departments to coordinate their work. The example shows how, in the words of Akkerman and Bakker (2011), phone-based images enhance the communicative connection between the diverse departments. These representations also help to translate the experiences of the on-call doctor and enable him to make a smoother and more fluent transition across departments, i.e. in this case across *non*-digital social spaces. In medical and clinical settings there are many artefacts such as displays or whiteboards, computers or gestures that provide representations which act as meditators of information and knowledge between different individuals and groups (Cohen, Blatter, Almeida, Shortliffe, & Patel, 2006; Pimmer, Pachler, & Genewein, 2013; Xiao, 2005). In these settings, mobile technology is of specific value as its portability and multi-media capturing features allow the ad-hoc generation and space-independent sharing of representations, supporting the coordination of work that is highly distributed in socio-cultural, disciplinary and physical settings.

In addition, this example illustrates that these re-contextualized representations also mediate experiences between actors with different levels of expertise. The on-call doctor is a resident, thus having relatively little medical experience compared to the head physician. While his ability to use the medical terminology to precisely describe more complex medical patterns is still limited, s/he is supported in his verbal "translation" efforts by the image.

Reflection

Crossing socio-cultural spaces can also facilitate mechanisms of reflection, i.e. make explicit differences between practices and learning something new about own and others' practices (Akkerman & Bakker, 2011). The use of mobile technology can stimulate reflection which is closely linked to sharing and discussing of work-based experiences in further, formal and informal contexts - in the sense of reflection on-action" (Schön, 1983, 1987). For example, in a current project (https://blogs.fhnw.ch/m4healtheducation/), nurses in South Africa reported documenting and sharing images across work and school contexts for reflective practice by means of mobile phones:

> When we are together [in university settings], we share and discuss the photo; some things [conditions] we learn in school take a long time to see [in practices settings]. So, when you witness this condition, and you are not together with your colleagues, you take this picture, [by means of the mobile…] then you look at the picture and, [later] discuss on it, if it corresponds with what we have learned. (nurse)

The example shows how the mobile phone-based multimodal representations are

used to contrast and reflect on the perspectives and practices between relatively formal school settings and informal learning in the workplace. This does not happen in a non-recurring and linear way, but allows for iterative learning cycles between formal and informal contexts. In this project, we also found examples of nurses who had formed "mobile Facebook" groups in school and subsequently reported and contrasted different practices of how they treated patients, thus extending their perspectives by learning something new about their own and their colleagues' practices. As the nurses had specialised in different professional areas, problem-solving and reflection in this group benefited from the interdisciplinary knowledge brought together by the diverse actors (Pimmer et al., 2014). In the literature a number of studies show how reflective practice that results from bridging diverse, formal and informal learning spaces is facilitated by the use of mobile media: for example, one study confirmed the effectiveness of a system that allowed school teachers to send daily questions to the mobile phones of their apprentice students - who were distributed across different work settings. These were prompts to provoke reflection like "I have felt myself needed today", or "I have learned new things today". The feedback of the apprentices was collected, analysed and used to illustrate practice experience back in formal school settings (Mettiäinen & Karjalainen, 2011; Pirttiaho, Holm, Paalanen, & Thorström, 2007).

These practices do not only allow for a comparison and critical reflection of learning across different socio-cultural sites, but they can also lead to a broader set of perspectives and support the new construction of identities, as emphasized by Akkerman and Bakker (2011). This has been demonstrated by a study in which foreign language students tape-recorded authentic situations in which they practiced speaking. Later in the classroom the students jointly listened to and reflected on the recordings. In so doing, mobile technology was used by learners in the crossing of boundaries between informal, familiar and personal spaces and the more formal and authoritative settings of the classroom (Calic & Neijmann, 2010). At the beginning, the bridging of these very different social spaces challenged the participants. Listening to their own voice and bringing personal, intimate recordings into formal settings made them feel uneasy and aware of their insecure sense of the self (in the target language). Over time, through the continued boundary crossing and adherent reflection on own and their peers' practices (documented in the form of audio-recordings), the students revisited their self-perception and gained a new identity as foreign language speakers, i.e. a new sense of who they were in the target language.

Transformation

The fourth learning mechanism discerned is that of transformation, i.e., the profound change of practices or the creation of new ones by means of boundary crossing.

Viewed in this way, in many of the aforementioned cases the appropriation of mobile technology has already resulted in new boundary crossing practices, i.e. in novel ways to reach different social worlds in a situation of learning and problem-solving. For instance, the example of the Facebook site that entailed identification mechanisms (Pimmer, Linxen, et al., 2012) represents a completely new form of engagement in novel spaces created itself by the learners' boundary crossing. Akkermann & Bakker (2011) conceive transformation to be triggered by the "confrontation with some lack or problem that forces the intersecting worlds to seriously reconsider their current practices and the interrelations". Considering mobile learning cases, I would argue that, at the beginning, it is not exclusively a problem that causes transformation. In addition, a new technological artefact can also offer affordances for communication and learning practices (across and within) boundaries, which then leads to new tensions; an observation that relates to the notion of transformation suggested by Y. Engeström (2001): a system (e.g. a classroom community) that adopts a new element (e.g., mobile phones) from the outside experiences structural tensions and contradictions, as rules collide with the new practices. Contradictions can lead to innovative approaches to changing the activity and to re-contextualizing it in the socio-cultural environment. This appears to be particularly true when we consider how practices from informal and leisure time contexts start to transcend more formal learning spaces such as the classroom or work contexts.

For example, in one study in Nepal we observed how conflicting practices from inside and outside the classroom resulted in the co-development of a new practice over time. While students were using mobile phones to document images in their leisure time, this was initially prohibited in the classroom. However, after a while, the students were allowed to use their phones for documentation, but only *after* teaching (Pimmer, Linxen, Gröhbiel, Jha, & Burg, 2013). This example allows for three interesting observations. Firstly, the practice involves boundary crossing: photographs from the classroom and work-based placements were further shared in the students' study communities (an informal learning context) - as one student exemplifies: “This is the [medical] case I have seen.” […] We proudly show it to the others." (Pimmer, Linxen, et al., 2013). Second, the practice itself is crossing the boundary between the private and education spaces: the practices of taking photographs has been created in the users' private spheres and has been carried by the learners as "boundary brokers" into new, more formal educational contexts. This has met with resistance from historically grown systems and causes confrontation. For example, faculty and teachers were generally concerned about the use of mobile phones during placements and in the classroom. In addition, the adoption of mobile media also impacted on underlying cultural models of hierarchy and teaching - challenging teachers and education institutions in their function as gatekeepers of knowledge. Third, the practice was not simply copied from one site into another. Instead, negotiations

between students and teachers resulted in the creation of a new, in-between practice, i.e. a practice which was re-contextualized in the new environment (students allowed to document *after* teaching).

Boundary crossing in a wider context

Drawing on the analysis from the previous sections I establish in the following the notion of mobile phones as boundary crossing tools. In addition, I discuss my arguments in the light of other sociological concepts and societal and educational developments.

Mobile (social) media as boundary crossing tools

I argue that mobile phones can be perceived as boundary crossing tools since they are used by learners in their trajectories across their digital and *non-digital* social networks. As the examples have shown, this is specifically facilitated by the generation of multimodal representations (i.e., text, audio, photographs) in one and their sharing in further social network spaces by means of mobile phones. This pattern relates to the notion of stigmergy, as used by Yrjö Engeström (2009) in his work on wildfire activities such as skateboarding or birding. Stigmeries, such as a set of videos created and shared by skateboarders, are not only traces of experience (and identities) but can represent the very social glue of these loosely coupled communities and enable subtle coordination in them.

The affordances of mobile technology in terms of boundary crossing are even more evident when we consider the convergence of mobile and social media, i.e. when the capacities of mobile phones and social software are merged: this means that the portability, communication and multimedia capturing functions of mobile phones are combined with the networking functions of social software. This development is also interesting in the light of a broad evolutionary perspective: Geser (2004) describes the significance of the mobile phone to lie in empowering people to engage in communication, which is at the same time free from the constraints of physical proximity and spatial immobility. While these affordances respond to deeply ingrained and universal social needs, one of the main limitations is that traditional phone conversations are limited to bilateral interactions. This is a constraint that, according to Geser (2004), still requires space-dependent interactions for supporting multilateral interaction fields, as well as more tightly integrated and physically bound collectivities like communities and organizations. However, the convergence of mobile and social media at least partly overcomes this restriction by allowing for more complex multilateral and networked engagement of people who are on the move, i.e. physically distant and away from stable dwelling settlements.

Mobile learning as boundary crossing manifests itself in the form of cognitive learning processes (such as reasoning and reflecting), socio-cognitive learning and communication practices (such as joint problem solving and collaborating), and, importantly, in terms of socio-cultural forms of learning by participation, the transformation of practices and identity formation in communities of practice: the examples have shown how the learners' engagement throughout different social spaces re-construct identities and support the new development of identities, such as the identity as foreign language speakers. Identity formation is of specific relevance as it is both a result and at the same time an enabler of learning across boundaries: putting it in the words of Wenger, "Identity is the vehicle that carries our experiences from context to context" (Wenger, 1998).

I prefer the notion of boundary crossing *tools* over that of boundary objects. This emphasises their active use and stresses the agency of the learner, i.e. their capacity to act on the world by appropriating mobile technologies as cultural resources (as also proposed by Pachler, Bachmair, et al. (2010). *Boundary crossing tools* are also different to *boundary objects,* as coined by Star (Star, 1989, 2010). She characterizes the role of boundary objects as a set of arrangements that resides between two social worlds or groups and allows them to cooperate without consensus. I argue that this account is too narrow to fully explore the affordances offered by mobile technology for boundary crossing. I foreground a perspective according to which mobile phones are used by learners in their boundary-crossing between different socio-cultural sites, with and without consensus. In addition, the concept of "tools" cannot be confounded with "objects" in the sense of the "object-orientedness of action", as used in activity theory, for example by Y. Engeström (2001).

I also suggest viewing mobile phones as tools that are used by learners to navigate across *networks* (instead of social groups) following the terms of Wellman and Geser (Geser, 2004; Wellman, 1999, 2001): networks in the sense of decentralized social spaces constructed by each individual according to his or her personal capacities and needs, and constantly reshaped by social interactions. Similar to a digital Social Network Site (SNS) there is no centre, but each individual represents the hub of his own self-created and personal(ised) network. This is in contrast to groups in the sense of neatly confined supra-individual collectivities shared identically by many members.

Learning across heterogeneous and peripheral social networks

As I've discussed in the previous sections, boundary crossing by mobile phones involves the learning mechanisms of identification, coordination, reflection and transformation. We have seen that a range of different boundaries can be crossed by means of mobile technology: between professions, between 'novices' and 'experts', throughout diverse cultural/geographical spaces, and across formal learning spaces,

such as the classroom, and more informal learning settings, such as the workplace. When mobile (social) media is used by learners in their trajectories across different socio-cultural sites, these spaces are connected more tightly. This crossing can be linked to the notion of "bridging social capital" as coined by Putnam (2002): social networks that bring together people from diverse backgrounds (more closely). The affordances of mobile phones and social networking technology to bridge social capital and to scaffold equity of access to cultural resources have been already foregrounded by Cook, Pachler, and Bachmair (2013). Supporting this argument, empirical studies show that digital technology and specifically social network sites such as Facebook favour the bridging of social capital (Ellison, Steinfield, & Lampe, 2007; Tomai et al., 2010): for example, Facebook enabled students to interact with peers from different cultures and nations (Jiang & de Bruijn, 2013).

Bridging social capital is similar to boundary crossing as defined by Akkerman and Bakker (2011), who focus on the intersection of different socio-cultural settings. However, in view of mobile learning, I would like to offer a slightly extended view of boundary crossing. We can also observe that, in addition to the focus on differences, mobile phones can also help to reach peripheral social spaces, and thereby tighten one's social networks. These are spaces made up of social actors who are not necessarily very different, but out of the learners' daily reach: loose and infrequent connections - unless linked by means of a mobile phone. In this respect, Geser (2004) stresses the capacity of mobile phones for the enlargement of peripheral relationships and for the strengthening of weak social ties. Weak ties are, broadly speaking, loose and less tightly involved social connections which are usually activated only under specific circumstances (Granovetter, 1973, 1983). Supporting these arguments, Ahmad and Orion (2010) described that, in a company, the use of mobile phones (compared to desktop computers) facilitated the communication of individuals with their weak ties. These were 2nd or 3rd level contacts from the same company, who were nevertheless outside the usual day-to-day interactions. This is important as the strengthening of weak ties, or the transformation of latent into weak ties, provides individuals as well as organisations with *more* information, the latest ideas, and also learning opportunities (as opposed to strong ties, i.e. frequent connections such as close friends and family).

Boundary crossing, TEL and contemporary developments

Boundary crossing, social capital and weak ties are not only important on individual or organisational levels, but also from a broader societal perspective. Social capital is deemed to be specifically valuable in the context of crises, as stressed by Woolcock and Narayan (2000).

> "Intuitively, then, the basic idea of “social capital” is that one’s family, friends, and associates constitute an important asset, one that can be called upon in a crisis, enjoyed for its own sake, and/or leveraged for material gain."

They further emphasize that communities with a diverse stock of social networks and civic associations will be in a stronger position to confront poverty and vulnerability, resolve disputes, and/or take advantage of new opportunities (Woolcock & Narayan, 2000). Of similar societal importance is the existence of weak ties, as stressed by Granovetter (1983). He argues that, from a macro-perspective, social systems with limited weak ties are likely to become fragmented and incoherent, since innovation and new ideas hardly transcend segregated subgroups. It is interesting to note that the rise of mobile phones and the intensive use of social networking sites coincide with times of economic turmoil and crisis in high income countries. For example, the populations in many European countries are threatened by unemployment and poverty and lack confidence in formal societal structures (Red Cross Report, 2013). At the same time, the value of formal education is eroding. Even higher education is no longer a "safety net" against unemployment (Livanos & Núñez, 2012). Against this background Pachler, Cook, and Bachmair (2010) foreground that today's societies which are characterized by individualized risks and a process of on-going individualization (Beck, 1992) require and support new characteristics of agency; agency, as I would argue, that can make use of the affordances provided by mobile technology to strengthen and spin one's social web across more heterogeneous and more peripheral spaces. For example, referring again to Granovetter (1983), it has been observed that individuals who cross boundaries in that they expand their peripheral network of weak ties have more job opportunities since they receive job information also from distant spaces of their networks (Granovetter, 1983).

Not only individual learners but also educational institutions are facing increasing pressures and risks from wider social and economic developments while moving out of the established frontiers of public service metiers into what Traxler and Lally (in this volume) label as "competitive industrialisation of Higher Education". That is, higher education institutions that are becoming increasingly "competitive, marketised, specialised and privatised". This development is also characterized as massification of higher education, a phenomenon tied to the diversification and specification of as well as to the increased control over academic tasks (Musselin, 2007). These dynamics also shape, and are shaped by the use of (educational) technologies by these institutions. In this respect, the "first generation of industrialised learning" (using the terms of Traxler and Lalley) has supported the standardized production of educational goods. Drawing on the arguments of Musselin (2007), technology was adopted in a way that has started to transform lecturing from "handiwork" of an individual teacher to the creation and delivery of more generic and products, i.e. "harmonized" curricula.

Lecturing shifted from personal activities that are carried out by one teacher to a more specialised and standardized exercise involving the expertise of producers, tutors and technological experts. The "second generation of industrialised learning" represents now a further shift marked by mass customization, i.e., the flexible design and delivery of mass educational services tailored to the demands of individual learners. It can be noticed, however, that higher education institutions still tend to cultivate closed spaces and are struggling to connect with the habitus of their "clients" that has evolved in their life worlds. That is, the manifold ways how users experience increased ownership, personalisation and ubiquitous connectivity of personal mobile devices which they use to weave and extend their social webs across previously established boundaries. These practices are widely unmediated and unimagined by education and work institutions. For example, according to a recent review of Manca and Ranieri (2013), Social Network Sites are incorporated in contemporary educational settings rather as "fenced spaces" (i.e., with closed boundaries) in ways that do not integrate the different and heterogeneous sources that are potentially available in networked environments. Another, often neglected aspect to be considered is the fact that most of the recent Network Sites are commercial in nature. Their main purpose is not to produce societal or educational benefits but to generate revenue through marketising their users' personal information. This orientation is resulting in properties and practices that do not necessarily foster critical debate but conviviality and uniformity (Friesen & Lowe, 2012). Thus, a key question that remains to be answered is how education institutions can connect with these new learning and boundary crossing practices without adhering to the globalising corporatism and shallow consumerism.

Concluding remarks

To conclude, I wish to re-emphasise the role of mobile technology, and specifically mobile social media, as boundary crossing tools that can be tied to the learning mechanisms of identification, coordination reflection and transformation. This is specifically facilitated by the capacities of mobile phones to generate multimodal representations that reflect the learners' experiences and identities, and to share them across their digital and non-digital social networks. I argue that the learning mechanisms are not only enabled by the heterogeneity that results from socio-cultural differences of different network spaces. In addition, learners use their mobiles as a means to strengthening peripheral network relations in ways not previously possible. The affordances of mobile phones for boundary crossing appear to be of specific relevance in times of socioeconomic transformations with weakening educational structures.

Of course, the scope of this paper has permitted only limited engagement and allows no definitive conclusion regarding the complex and multi-faceted phenomena

at hand. However, I hope that my arguments have offered broadened perspectives and new trails for future exploration. On a general level, I encourage future research to pay more attention to the capacities of mobile networking technologies to enable learning beyond closed digital spaces. The need for more research on boundary crossing is specifically evident considering the fact that most of the mobile learning research is concentrated on the use of mobile technology within higher education (Hwang & Tsai, 2011; Wu et al., 2012). In the future we may address questions such as: are there more boundary crossing mechanisms that the ones borrowed from the framework of Akkerman and Bakker (2011)? It also needs to be analysed whether and how formal educational institutions can and should connect with these dynamics. Importantly, I've focused on the affordances of mobile technology to enable learning by crossing boundaries. It needs to be acknowledged that digital and mobile technology can maintain or even widen pre-existing boundaries (see for example Rice & Katz, 2003). And, an increase in online social networking activities does not per se result in a broadening and more heterogenic public discourse: conversely, a recent study points to the view that users are less willing to share potentially conflicting and controversial issues via social networking sites such as Facebook and Twitter than they were in person (Hampton et al., 2014). Accordingly, future work may not only concentrate on the dynamics that increase and lower the permeability of boundaries but also consider how boundary crossing contributes to a more or less immersive and diverse debate.

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