Designing Technology Enhanced Learning Contexts

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Abstract: Through iterative participatory design-based research I aim to explore the application of the Ecology of Resources (EoR) Framework (Luckin, 2008) to the design of technology enhanced contexts that scaffold learning and collaboration. Technology enhanced learning (TEL) contexts engage learners and the ecology of resources available to them as they move through time and space, in coordinated and distributed activity towards learning. Such ecologies may include technology, environmental features, humans and any other resources that can support learning. The challenge is to help the learner become aware of, access, and co-ordinate her interactions with these resources. I will formatively evaluate the EoR through participatory design of TEL contexts that scaffold language learning using mobile technology. Face-to-face and remote collaboration with teachers, native speakers and other learners will be a central part of this technology-enhanced language-learning context.

Background

Learning takes place throughout the full range of contexts in which humans operate and frequently it is the context that determines success or failure of a learning activity. While designers of TEL have long recognized the impact of the contex in which a system is used (Wood, Underwood & Avis, 1999) attention has tended to focus on understanding formal and relatively static settings. More recently personal and mobile technologies have extended TEL opportunities to all contexts in which we live and learn while also enabling change and disruption in the more familiar and traditional contexts of learning (e.g. mobile phones in schools). This situation has led to the exploration of a much wider range of learning contexts and new approaches to understanding these. However, context is still typically understood in terms of the features of a location or range of locations. As digital technology becomes increasingly personal, mobile and ubiquitous it is important to move beyond static and location-based models of context to an understanding of the dynamic learner centred context created by a learner's interactions with the ecology of resources within which she moves.

Designers of TEL systems have employed various approaches to better understand contexts of use. Contextual Design (Beyer & Holtzblatt, 1998) provides insight through workplace observations, interviews and mapping activities. Other approaches employ ethnographers or engage users as proxy ethnographers in detailed observation of activity over protracted periods of time. Participatory approaches bring designers and users together and enable users, with detailed understanding of their own contexts, to co-design contextually appropriate systems. However, as designers of TEL *contexts*; systems that are distributed across technologies, humans and other resources; we need to understand context not only in terms of its impact on the way learners use systems but also in terms of the ways in which technology can exploit context to better support learning. Research in ubiquitous and context-aware computing contributes to such and understanding.

Dey (2001) defines context as the information that characterizes a particular situation with respect to an entity; Dourish (2004) highlights the importance of the surrounding human activity and Chalmers (2004) notes the importance of the history of previous interactions to current context. Similarly, Beale and Lonsdale (2004) describe context as changing relationships that may be shaped by their own history. Drawing on these descriptions and a sociocultural account of learning (Vygotsky, 1986) Luckin (2008) suggests that, for a learner, context is defined through her relationships and interactions with the ecology of human and other resources she encounters as she moves through time and space and that these are themselves situated historically and culturally. From a learner's perspective, context is the current conditions of her situation in a physical and social environment, *as she perceives it*, shaped by her previous experience and expectations. This is similar to Wertsch's (1984) situation definition; situations consist of participants' interpretations of physical space, their own roles and status, the task, and the concrete objects in the space (Park & Moro, 2006). Hence, we arrive at an understanding of context that is dynamic, learner centred and also recognises the importance of the various participants' (e.g. teachers, learners, designers) differing interpretations of that context.

The Ecology of Resources

Luckin (2008) describes a learner's context in terms of inter-related elements (knowledge, environment and resources) and corresponding filters. In other words: What is to be learnt, and the way in which this is recognized, validated and structured as a skill or knowledge in formal and informal ways; The social and physical environments with which the learner interacts and the organisation of these; Resources both human (e.g. peers, teachers, parents) and inanimate (e.g. books, WWW, microscopes and telescopes) and the administration of these. These elements of the EoR are situated within and filtered by the prior cognitive structures which exist both in the learner's subjective consciousness and the objective world, embedded into

technologies, organisations and other "persistent structures" (Nardi, 1996) such as norms and legal procedures. For the learner, filters both channel in and filter out aspects of the surrounding world. Hence, the range of possible interactions a learner may have is constrained by what is actually available and by the organisational filters and socio-cultural filters active at this moment in time and space. A third layer of filters acts at the level of the learner; her body and senses shape the way she perceives and interacts with the world around her, as do her emotional and cognitive state (Niedenthal, Barsalou, Winkielman, Krauth-Gruber & Ric, 2005). The utility of identifying these filters is revealed when we turn our attention to learning.

Westerman et al (2007) describe how the young infant's limited visual acuity and motor control filter her sensory experience of the world and suggest the gradual fading of these constraints, as the infant body develops through interaction with the environment, is what results in an orderly and gradual understanding of the complexity of the external environment. Filters at other levels in the EoR may be adjusted to support learning in a similar way, for example a curriculum may structure a learner's exposure to a body of knowledge so as to gradually increase complexity. Similarly access to resources (e.g. dictionaries) may be administered so as to enable a learner to perform tasks (e.g. read a foreign language) above her current level of competence. Hence, in design the EoR draws our attention to the ways in which we might support learning by adjusting the various filters that stand between a learner and the resources, environment and knowledge that surround her. When such adjustments are dynamic, enable performance at a higher level than the learner's unassisted competence but within her Zone of Proximal Development (ZPD) (Vygotsky, 1986), and are faded as her competence increases, they are equivalent to *scaffolding* (Wood, Bruner & Ross, 1976) and can lead to learning. Other kinds of action on EoR filters are also possible and can also enable performance at higher levels and contribute to an improved context for learning; for example the provision of a telescope will enable a learner to see what she could not see previously. However, this kind of action has different consequences and may better be considered a way of distributing cognition or intelligence than scaffolding learning (Pea, 2004).

Scaffolding requires a more able partner that understands the learner. In TEL contexts, human and/or technology may provide scaffolding. Many systems have developed effective methods for modelling learners in order to provide appropriate help (e.g. Jackson, Krajcik, & Soloway, 1998). More recent systems have also modelled metacognitive and affective characteristics of the learner (e.g. Rebolledo, du Boulay, & Luckin, 2005). Less work has been done on systems that scaffold the learner's interactions beyond a bounded software system with the external world. The role of technology in TEL contexts may be to help find, make the learner aware of, connect her to and structure her interactions with the most appropriate resources (human, digital or other). This requires models of the learner's objectives, her current knowledge and context, the knowledge domain, and the filters between the learner and the available resources. Designing such TEL contexts brings together work in context aware computing, learner modelling and scaffolding and requires a deep understanding of the learner and her context. In order to formatively evaluate the utility of the EoR framework as a tool for the design of TEL contexts I plan to apply it to the design of support for adult foreign language learners

Mobile Assisted Language Learning (MALL)

The advent of portable and personal multimedia digital technology has placed what used to be the language lab, self-study and resource centre in the learner's pocket. This, together with near ubiquitous access to the Internet, Web 2.0 technologies supporting personal publishing and peer-to-peer collaboration and the ease with which audio-visual media can now be captured and shared, have created exciting new affordances for language learning. The language learner now has the potential to interact when and where they want with an immense and varied range of appropriate human (e.g. teachers, native speakers, learners) and other resources (e.g. dictionaries, concordancers, and authentic multimedia target language content). The challenge is to filter these interactions so as to create personal TEL contexts that optimally support language acquisition.

Underwood (2002) described how learner and content modelling techniques could be employed to structure interactions with target language content on interactive television in ways that support language acquisition. More recently, Fallahkhair, Pemberton, & Griffiths (2007) demonstrated the use of mobile phones to scaffold language learning from audio-visual content viewed on TV in a distributed system. The next step is to use mobile technology to scaffold language learning from authentic content in the wider world; for example to support 'on the spot' *noticing* and recording of relevant language features in the wild (Kukulska-Hulme & Bull, 2008). Kukulska-Hulme and Shields' (2008) review suggests MALL research has only just begun to explore the opportunities for using authentic multimedia content, supporting learner directed and situated learning and promoting 'collaborative speaking and listening activities that allow learners to co-construct knowledge'. However, a survey (Clough, Jones, McAndrew, & Scanlon, 2007) of experienced users found mobile devices were used to support self-directed informal learning, exploit unforeseen opportunities for situated learning and, in conjunction with Web 2.0 technologies, for collaborative learning.

Initially, I will work with a small number of experienced users of mobile devices who are also independent language learners to explore the use of the EoR framework both as a lense through which to understand the opportunities afforded by mobile technology and as a tool in the participatory design of TEL

contexts. This will involve studying learners in context, using the EoR to map their learning contexts and the ways they already use mobile technology to support language learning, working with learners to identify both unexploited opportunities to employ existing technology to better support language learning and requirements and design challenges for new technology to better support language learning. This will lead to iterative design experiments (Brown, 1992) in which I will introduce prototype technology designs to create and evaluate novel TEL contexts. Throughout these studies I will use multiple methods to capture rich data about participants' language learning, use of technology and their contexts over extended periods of time. Methods will include: observation and video recording of selected key events (e.g. classes, self-study), self-report of unforeseen learning events, participant diaries, interviews and focus groups.

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