THE PROBLEM OF CONTEXT: THE CIRCUMSTANCES IN WHICH ICT CAN SUPPORT LEARNING

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Abstract

Context matters to learning; it is complex and local to a learner. Conceptualizing *context* so that, as designers and educators, we can understand and use it to better support the development of technology-rich learning activities is an important challenge. The Ecology of Resources model addresses this challenge and offers a way of characterizing a learner in terms of the interactions that form that learner's context. It offers an interpretation of Vygotsky's theory in the form of an abstract representation that can be shared by practitioners, technologists and beneficiaries as they explore the potential learning benefits afforded by the wide range of available resources, in particular technologies. It represents the learner holistically with respect to the interactions that make up their context.

Introduction

Very early in my academic career I was struck by the complexity and importance of the relationship between a learner and their *context*. I started to explore ways in which I could understand more about this relationship and its impact upon the manner in which learners (and teachers) might best use ICT so that their context could be taken into account in its use and design. One could think of context as the *circumstances* in which learning takes place, but what do we know and understand about these circumstances and their relationship to what people learn through ICT? This is the question I will explore through this paper and my associated presentation.

There is nothing new about the suggestion that one should explore a learner's context in order to understand more about their learning (see for example, Mercer, 1992; Wood, Underwood, & Avis, 1999). Previous research has confirmed the importance of looking at the wider environment, but has been largely limited to specific environmental locations, such as university lecture halls, school classrooms or 'the workplace'. This approach limits consideration to just one of the many environments with which and in which a learner interacts.

A learner-specific definition of context is needed if we are to address this limitation and develop technology-rich learning that takes advantage of the potential afforded by the wide range of evolving ICTs that can support interaction across multiple physical and virtual spaces, multiple knowledge domains, multiple time periods and with multiple collaborators. The provision of such a definition is not an easy task, context is a complex concept (Nardi, 1996) and very difficult to 'pin down' in a way that enables it to be used as the basis for constructing a design framework.

In Luckin (2010, p. 18), I initiate my discussion of context through consideration of the range of ways in which the word 'context' is used within and across multiple disciplines. My aim is to identify common themes that transcend disciplinary boundaries and to arrive at a definition of context that can be used as the basis for developing a framework to support the design of technology-rich learning activities. The discussion encompasses work drawn from geography and architecture, anthropology and psychology and from education and computer science and concludes with the proposal that:

> Context is dynamic and associated with connections between people, things, locations and events in a narrative that is driven by people's intentionality and motivations. Technology can help to make these connections in an operational sense. People can help to make these connections have meaning for a learner. A learner is not exposed to multiple contexts, but rather has a single context that is their lived experience of the world; a "phenomenological gestalt" (Manovich, 2006) that reflects their interactions with multiple people, artefacts and environments. The partial descriptions of the world that are offered to a learner through these resources act as the hooks for interactions in which action and meaning are built. In this sense, meaning is distributed amongst these resources. However, it is the manner in which the learner at the centre of their context internalizes their interactions that is the core activity of importance. These interactions are not predictable but are created by the people who interact, each of whom will have intentions about how these interactions should be.

This specification offers a starting point for developing a clearer way of talking about context, but it needs further integration with learning theory if we are to use it to develop something really useful to support the development of ICT for learning. The socio-cultural approach of Vygotsky (1986) offers compatibility with a context-based model of learning. In particular, if one considers the Zone of Proximal Development (ZPD) as the crystallization of the internalization process that is at the heart of learning, then the ZPD can be thought of as a context of productive interactivity. This conceptualization emphasizes the important role played by the society within which the learner interacts and in particular the more knowledgeable, or more able, members of that society — members who are lecturers, teachers, trainers and parents, for example. The ZPD is useful, but it

requires further clarification and specification (Wertsch, 1984; Wood, Bruner & Ross, 1976). The Zone of Collaboration is an interpretation of the ZPD concept that offers a way to provide this clarification and specification. It involves two constructs called: the Zone of Available Assistance (ZAA); and the Zone of Proximal Adjustment (ZPA). The ZAA describes the variety of resources within a learner's world that could provide different qualities and quantities of assistance and that may be available to the learner at a particular point in time. The ZPA represents a sub-set of the ZAA that is appropriate for a learner's needs.

This Zone of Collaboration concept is integrated with the description of context outlined above to form the Ecology of Resources model of context. This model is intended to act as a useful mediating artefact to integrate work across the various subfields involved in the development and use of ICT to support learning: computing, psychology and education, for example.

The Ecology of Resources Model of Context

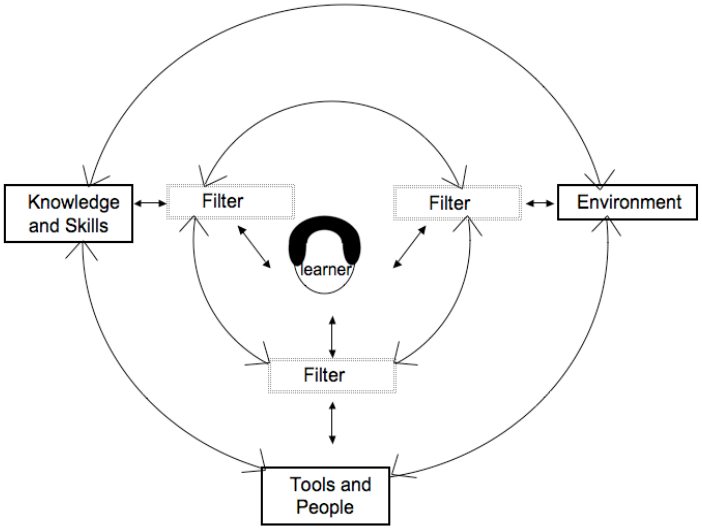
The Ecology of Resources model is illustrated in Figure 1. It develops the ZAA and ZPA concepts into a characterization of a learner along with the interactions that form that learner's context, its full detail can be found in Luckin (2010). Here I describe it briefly in order to support the suggestion that it might act as a useful mediating artefact to integrate work across various subfields; to situate the presentation of the design framework and to ground an empirical example.

The resources that comprise a learner's ZAA embrace a wide range of categories, including people, technologies, buildings, books and knowledge. It is useful to consider the different types or categories of resource that might be available in order to identify them and the relationship they bear to the learner and to each other. One of the resource categories that the learner needs to interact with comprises the 'stuff that is to be learnt': the knowledge and skills that are the subject of their learning. A second category of resource is that described as Tools and People in Figure 1. This category includes books, pens and paper, technology and other people who know more about the knowledge or skill to be learnt than the learner does. The last category of resource is that represented by the Environment label in Figure 1. This category includes the location and surrounding environment with which the learner interacts: for example, a school classroom, a park, a virtual world, or a place of work. In many instances, there is an existing relationship between the resources within these three categories: Knowledge and Skills, Tools and People, and Environment. For example, the book resources appropriate for learning science are located in the science section of the library and formal lessons probably take place in a particular location in school. Hence, in Figure 1 the categories of resource surrounding the learner, and with which they interact, are joined together. In order to support learning, the relationships between the different types of resource with which the learner interacts need to be identified and understood. They may need to be made explicit

to the learner in order to build coherence into the learning interactions. For example, if we wish to teach the concept of food chains, then we might decide to make a visit to a pond, or a garden in order to observe the animals and plants that live there and to talk about the feeding relationships that are required to support the particular ecosystem.

This food chain learning example highlights another factor that needs to be taken into consideration. I suggested that as a teacher I might organize for learners to make a trip to a local pond or garden. This is an example of the way in which a learner's interactions with the available resources are often filtered by the actions of others rather than experienced directly and unimpeded by the learner. In this example the teacher usefully filters learners' interactions with the world to illustrate food chains 'in the wild'. Filters can be positive or negative. For example, the subject matter to be learnt is usually filtered through some kind of organization, such as a curriculum, that has been the subject of a process of validation by other members of the learner's society. This resource filter is stronger for subjects such as formal educational disciplines than for more grounded skills. However, even with skills-based subjects there is, to some extent at least, still some formalization of what is recognised as the accepted view about the nature and components of the skills that need to be mastered. The tools and people that may be available to the learner are also organized or filtered in some way. For example, a teacher taking a science class is probably only available during that class, or perhaps at some other times via e-mail. Classroom technologies are not always available to learners whenever they want: there are school rules and protocols that restrict the learner's access to these resources. Finally, and again as reflected in the food chain example, a learner's access to the Environment is mediated by that environment's organization. This resource filter is more obvious in formal settings such as schools, where timetables and regulations have a strong influence on the ways in which learners interact with their environment. In the same way that there may already exist a relationship between the different resource elements in the outer circle of the figure, there may also exist a relationship between the filter elements. The coherence of the learner's experience can be enhanced through careful consideration of the existing relationships between the filter elements and between the individual resource elements and their associated filters. All of the elements in any Ecology of Resources bring with them a history that defines them, as well as the part they play in the wider cultural and political system. Likewise, the individual at the centre of the Ecology of Resources has their own history of experience that impact upon their interactions with each of the elements in the Ecology.

Figure 1: The Ecology of Resources Model



(Luckin, 2010)

The Ecology of Resources Design Framework

The Ecology of Resources model offers a way of characterizing a learner in terms of the interactions that form that learner's context. It is based upon identifying the forms of assistance available to a learner that make up the resource elements with which that learner interacts. The Ecology of Resources model could be viewed statically as merely a snapshot of the set of elements that describe a learner's ZAA and that can be 'optimized' by design and/or by practice. The model can also be seen as the basis for a dynamic process of instigating and maintaining learning interactions in technology-rich environments. The objective of the framework presented here is to support the dynamic process of developing technology-rich learning activities. The aim of the Ecology of Resources framework is to map out the complexity of this design process so that it can be conducted with an enhanced awareness of the complex nature of the learner's context. This does not mean that the entire complexity can be taken into account within the process, merely that a greater understanding of the complexity enables the process, and the resultant technology-rich learning activities, to be more effectively situated. In particular, the design process supported by the Ecology of Resources framework identifies the ways in which technology, people and the learners themselves can best support learning. If the Ecology of Resources model and its associated design framework are to be useful to a design team the overarching aim of their design process must be to engage with the learner's context as part of that process.

The Ecology of Resources Framework offers a structured process based upon the Ecology of Resources model of context, through which educators and technologists can develop technologies and technology-rich learning activities that take a learner's wider context into account. The process is iterative and has three phases, each of which has several steps. Each phase and step is intended to be completed through collaboration between beneficiaries and designers through a participatory design process. A full account of the framework can be found in Luckin (2010); here I explain it relatively briefly through an example. I will offer a variety of examples as part of the conference presentation. The Ecology of Resources Framework has three phases, each of which has multiple steps.

1. Phase 1: Create an Ecology of Resources Model to identify and organize the potential forms of assistance that can act as resources for learning.

   Step 1 — Brainstorm potential resources to identify learners' ZAA

   Step 2 — Specify the focus of attention

   Step 3 — Categorize resource elements

   Step 4 — Identify potential resource filters

   Step 5 — Identify the learner's resources

   Step 6 — Identify potential more able partners

2. Phase 2: Identify the relationships within and between the resources produced in Phase 1. Identify the extent to which these relationships meet a learner's needs and how they might be optimized with respect to that learner.

3. Phase 3: Develop the scaffolds and adjustments to support learning and enable the negotiation of a ZPA for a learner. Phase 3 of the framework is about identifying the possible ways in which the relationships identified in Phase 2 might best be supported or scaffolded. This support might for example be offered through the manner in which technology is introduced, used or designed.

The Ecology of Resources Design Framework in Use

The Ecology of Resources approach has been used in a variety of projects that include science learning in school, informal and formal learning in the developing world and home education in the UK. It is currently being used to support an adult second language learning study. In the following sections of this paper I expand upon one example in order to explain the framework in action. I focus in

particular upon the early stages of the design process and will offer more information about the later stages and further examples from different case studies within my conference presentation.

The example I draw upon for the case study below was completed with a learning centre in the South East of England that operates a self-managed learning (SML) process for 11–16-year-old learners in an 'out-of-school' environment. Self-managed learning is about learning to learn within the context of the individual and the wider community. Consequently, learning within the centre is not formalized to the same extent as in more traditional educational contexts. However it is still the case that many of the learners are seeking to gain formal educational qualifications. A key aim of the design process described in this case study was to explore and model learners' contexts to identify ways in which available resources might best be used to support their learning needs. These issues were addressed through an iterative participatory design approach in collaboration with learners and staff at the learning centre. It took the research team several interview sessions and observations with learners and mentors to identify and clarify the focus of attention used at the start of this case study.

Phase 1: Design Framework

Step 1 — Brainstorm potential resources to identify the learners' ZAA. Initial explorations with learners and staff at the centre revealed that although learners had access to a wide range of technologies for both formal and informal learning, they did not find it easy to make connections between these technologies, their learning activities and the available spaces for learning. In Table 1 I illustrate the iterative process at Step1 that led to the framing of an initial ZAA based on a loosely framed design need, which focused on the learners' selection and use of technologies on trips. This widely framed ZAA fits with the notion that the initial step of Phase 1 of the design framework aims to provide the widest possible ZAA on the basis that this may need to be revisited across several iterations. This preliminary ZAA enables the design process to move onto Step 2 and is the target of subsequent revisions through subsequent design iterations.

	Design Problem: (Generic)	**Characterising the learner, the learning context and learners' interactions with their context and available technologies**		
	Design Motivation	**Design Activity**	**ZAA**	**Issue**
1	Characterising learner, learning context and available technologies	Exploring the learning context using informal chat, observations, photographic data,	Generic, general overview of spaces, people, tools, practices, technologies and activities	Skills gap — technical support multi-context use of technologies

		documentary data		
2	Linking learners, contexts and technologies	Exploring multiple learning contexts drawing on more detailed participant perspectives through focused individual interviews	Focus down on multiple contexts for learning and use/non-use of technologies for learning	Skills and knowledge gap — use and selection of technologies across contexts (technical and pedagogical gap)
3	Linking learners and technologies to trips/visits	Exploring learning environments and learner practices and perspectives on technology use in relation thereto through focused group discussion	Focus down on external learning contexts and learner perceptions of learning with technologies	Skills and knowledge gap — some awareness of technical issues, low level learner awareness of pedagogical issues
4	Linking learners and technologies to specific trips	Exploring learner perceptions of relationships between trips, technologies and learning through targeted group discussion (semi-structured interview)	Focus down on practices and learner's resources (e.g. motivation, interest). Distinctions made between studying/learning leisure/learning interests/learning and intrinsic/ extrinsic motivations	Skills and knowledge gap — use of technologies for learning green issues problematic (locale, transport, rules in public spaces) Distinctions between productivity/creativity spontaneity/planning serendipity/purpose

Step 2 — Specify the focus of attention. At the end of Step 1 the goal of the design process had been specified as being: Linking learners and technologies to specific trips. A further set of iterations that moved between Steps 1 and 2 of the design framework was required to produce a sufficiently narrow focus of attention that was sufficiently fine-grained to enable progress to Step 3. The refinements that occurred through this process required further dialogue and interaction with participants and involved researcher participation in two trips organised by learners — one to a farm (local) which focused on formal study and learning biology and becoming a vet and one to the BBC (distant) which focused on leisure and learning film studies and becoming a film producer. In each of these instances, the design team (comprising researcher, learners and learning advisors) was able to observe and discuss available resources, with a particular focus on the category elements and filters of the Ecology of Resources framework. With the increased understandings of the learner's learning context across multiple locations gained through this participatory design process it was possible to generate an appropriate focus of attention: How can we support the learner to make appropriate selection and use of available technologies to learn about the Milky Way whilst on a trip to the London Planetarium?

Step 3 — Categorize resource elements. The identification of a preliminary set of resources enabled the generation of a preliminary Ecology of Resources model that was further refined and reshaped through steps 4–6. Steps 3–6 are enumerated sequentially, but it can be useful to develop Steps 3–6 in parallel, because identifying relevant filters and constraints requires a negotiation back and forth between resource elements and learner resources as well as consideration of the role of potential MAPs. It is not a matter, here, of trying to incorporate Steps 4–6 into the Ecology of Resources model generated at Step 3. It is, rather, a matter of identifying relevant resources and asking the following questions at each step.

Step 4 — Identify potential resource filters. What might restrict a learner's access to the forms of assistance identified thus far? Filters can act as constraints or opportunities, each of which can have positive/negative qualities. For example, for learners who want to learn more about the Milky Way, they might attend the Planetarium Show where they will learn about the Milky Way as part of a particular scheduled show. The show as a resource is filtered by time (show times, length of narrative/visuals about Milky Way), and by rules (no audio recording or photography allowed), which means that the learners must remember or record in a different way what, they are seeing/hearing. It is also filtered by ambiance (a darkened room) where lack of light acts as a constraining filter on their ability to make written notes, and by opportunity — if, for example, learners have a mobile phone, they could save text notes using the backlighting filter in the phone. The act of listening to the narrator and the presence of the audience acts as a constraining filter on the learner's ability to use available MAPs as *in situ* resources. Some of these issues could be addressed in the design process, e.g. by considering the use of GPS sensors which 'push' information to learners' mobile

phones at various locations or, for example, the learner could opt to receive additional digital information about specific knowledge concepts, e.g. the Milky Way, via Bluetooth to their mobile phone. All of these things act as potential filters in the learner's interactions with her context.

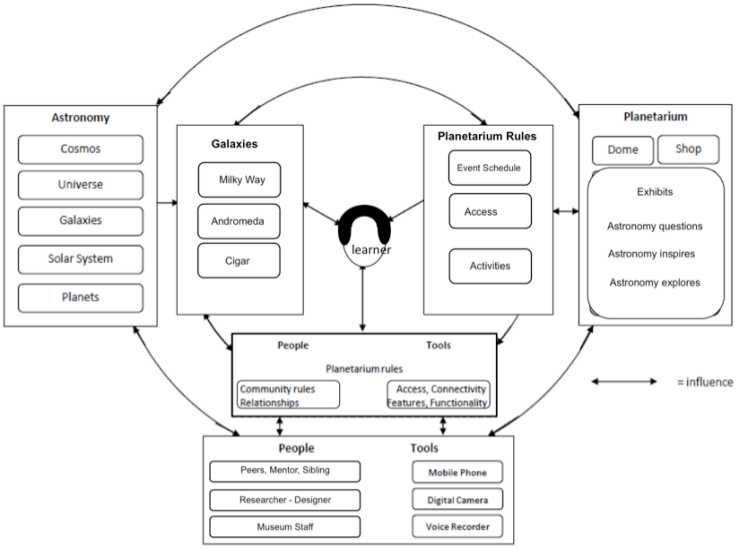
Step 5 — Identify the learner's resources. What are the resources brought to the situation by the learner? For example, some possible resources in the this case study were: co-ordination, curiosity, motivation/interest, existing knowledge, problem-solving skills, decision-making skills, planning skills, technical skills, learning models, learning styles, relationships, social skills, collaborative skills, communication skills, self-esteem.

Step 6 — Identify potential more able partners. Who or what are the MAPs and what role might they play? For example, a range of potential MAPs can be identified in the scenario of the learner at the Planetarium who wishes to learn more about the Milky Way. The stated purpose of the Ecology of Resources framework at Phase 1 is to identify and model a particular design need. Through the various iterations in Steps 1 and 2 and the subsequent review and revision of these resources in Step 3 and Steps 4–6, a subset of resources which were sufficiently scoped and relevant to the stated focus of attention for Phase 1 were produced to enable progress to Phase 2.

Phase 2: Identifying Relationships and Filters

The aim of Phase 2 is the identification of relationships and interactions that might influence the ways in which the resources, filters and MAPs may or may not be appropriated to act as forms of assistance for learners. The resources identified in this example are organized into groups according to the category elements and the relationships between the elements. Figure 2 illustrates a sample Ecology of Resources model of a learner's trip to the London Planetarium incorporating resources and filters based on the preliminary output generated at Phase 2. The model also incorporates arrows that highlight the relationships between these resources and filters. This Ecology of Resources model is still quite broadly framed but can nevertheless be used and reused to consider scenarios and options and to explore the learner's potential interactions with resource elements. The relationships and filters framing available resources and potential MAPs can be made more explicit. Opportunities for cross-location activities can also be generated and made visible. Mapping a learner's interactions in this way can provide a preliminary model for considering ways of developing effective scaffolds in both the learning process and the design process. Each of these resources and filters can influence any of the others and it is perhaps only with this understanding that the value of the Ecology of Resource framework really starts to become apparent and the interdependency of the component parts of the learner's context begins to emerge.

Figure 2: Ecology of Resources illustration for the Planetarium visit example



Phase 3 Identifying Scaffolds and Adjustments

The research of this case study was largely exploratory and focused on supporting learners' decision-making processes about appropriate and effective technology use to support their learning. Phase 3 therefore focused more on identifying, for future iterations, potential scaffolding opportunities. For example, an adjustment to the rules framed by copyright has been made in relation to the Exhibits hall, thus permitting learners to utilize their technology to capture data about their interests in astronomy, which they are later able to share with others, via Flickr, for example. A further example adjustment to this scenario could be made by making *in situ* provision within the Planetarium for visitors to share digital data captured in this way online, such as via a shared visitor website.

Conclusion

In this paper I have discussed the nature of the concept of context and have suggested that it is the role of the abler participants in a society to scaffold the construction of a narrative for those who are less knowledgeable or less able: the learners. Through this process the learner at the centre of their context internalizes their interactions and develops increased independent capability and self-awareness. The Ecology of Resources model and its associated design framework offers a way to talk about learners holistically — to sensitize us to the range of interactions that constitute their contexts. It frames a participatory design process that enables us to identify: the assistance that could be available to learners; the

ways that learners' interactions might be filtered, and the situations where scaffolding might be used.

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References

Luckin, R. (2010). *Re-designing learning contexts: Technology-rich, learner-centred ecologies.* Abingdon: Routledge.

Manovich, L. (2006). The poetics of augmented space. *Visual Communication, 5* (2), 219–240.

Mercer, N. (1992). Culture, context and the construction of knowledge in the classroom. In P. Light & G. Butterworth (Eds.), *Context and cognition: Ways of learning and knowing* (pp. 28–46). Mahwah, NJ: Lawrence Erlbaum.

Nardi, B. (1996). Studying context: A comparison of Activity Theory, Situated Action Models and Distributed Cognition. In B. A. Nardi (Ed.), *Context and consciousness. Activity Theory and human-computer interaction* (pp. 69–102). Cambridge, MA, MIT Press.

Vygotsky, L. S. (1986). *Thought and language.* Cambridge, MA: MIT Press.

Wertsch, J. V. (1984). The zone of proximal development: Some conceptual issues. In B. Rogoff & J. V. Wertsch (Eds.), *Children's learning in the 'Zone of Proximal Development'* (pp. 7–18). San Francisco, Jossey-Bass.

Wood, D. J., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry, 17*(2), 89–100.

Wood, D., Underwood, J., & Avis, P. (1999). Integrated learning systems in the classroom. *Computers and Education, 33*(2/3), 91–108.