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Modelling teenage personal contexts to support technology enhanced enquiry into personal energy consumption

Katerina Avramides*, Brock Craft, Rosemary Luckin

London Knowledge Lab, Institute of Education, University of London, 23-29 Emerald Street, London WC1N 3QS, UK

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ABSTRACT

Reducing energy consumption is becoming an increasingly high government priority. Teenagers are an important category of future energy consumers, but little is known of their conceptions about energy and, particularly, how formal learning about energy translates into understanding of personal energy consumption. We have worked with teenagers to investigate the design of learning technologies that support understanding about energy consumption in a way that is relevant to teenagers' personal contexts, including their motivations, concerns and conceptions, their personal energy consumption, and the sources of information about energy already available to them. In this paper we report on our findings and participatory design methodology. The findings contribute to our understanding of the support learning technologies must provide to scaffold teenagers' learning about personal energy consumption, in terms of how teenagers conceptualise energy consumption, what skills they have in searching for information, and what they consider motivating and relevant. Our methodology, more generally, contributes to our understanding of the initial phases of developing learning technologies that are grounded in an understanding of learners' personal contexts.

1. Introduction

We currently face important environmental and economic issues arising from energy consumption. Teenagers are an important category of future energy consumers. They are not the principal decision-makers within the household, but are well placed to have an impact, both by changing their individual behaviour and by acting to influence others within the family, their social networks and the public sphere (Larsson, Andersson, & Osbeck, 2010). Yet we know little about teenagers' understanding and behaviours around energy consumption and saving. We can, however, observe that energy consumption has been increasing (Abrahamse, Steg, Vlek, & Rothengatter, 2005). Also studies with adults suggest widespread lack of awareness of the energy intensity of different behaviours, indirect energy consumption (through products and services, as opposed to direct consumption of electricity and fuel), and lack of willingness to adopt changes in behaviour that have high impacts but are inconvenient (Lorenzoni, Nicholsoncole, & Whitmarsh, 2007; Whitmarsh, 2009). Some studies that have involved teenagers have presented a negative picture of their contribution to energy consumption (BBC, 2006; Thøgersen & Grønhøj, 2010).

Energy is a topic in the secondary school science curriculum in the UK (Department for Education, 2013). The curriculum currently includes learning about different forms of energy and different ways of generating energy, as well as associated environmental and economic issues, such as climate change and scarcity of non-renewable energy sources. Energy consumption and the problems arising from it are complex issues. Learners have difficulty applying their understanding of formal science learning to their personal circumstances (see Hung, Lee, & Lim, 2012, for a discussion of bridging formal and informal contexts of learning). For teenagers to understand about energy consumption, and be in a position to make informed decisions, they need to be supported in learning about energy consumption not as an isolated, abstract problem, but as linked to personal choices and behaviours. Therefore, learning about energy, and the issues associated with energy consumption, must be embedded in the everyday contexts in which energy-related behaviours and choices are made. Information must not only be personalised, but also presented in such a way that teenagers are motivated to engage with it. Learning technologies can be

* Corresponding author. Tel.: +20 7763 2137.
E-mail addresses: K.Avramides@ioe.ac.uk (K. Avramides), B.Craft@ioe.ac.uk (B. Craft), R.Luckin@ioe.ac.uk (R. Luckin).

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portable, flexible and adaptable, and, therefore, have the potential to enhance learning around energy by creating links between formal concepts and learners' personal contexts (Looi et al., 2010).

The study reported here is part of an ongoing project to understand how technology can support learning about energy in a way that is relevant to teenagers' personal contexts: their conceptions, motivations, and concerns around energy, their personal energy consumption, and the sources of information about energy available to them. In this paper we report on our findings and participatory design methodology to identify teenagers' personal contexts and draw connections between their circumstances, motivations, attitudes and knowledge. This work informs our understanding of how learning technologies can be designed with an understanding of learners' personal contexts. The aim is to provide tools for a process of enquiry into personal energy consumption that is meaningful and relevant to teenagers.

2. The project and methodology

The study reported here is part of an ongoing project that aims to design technological interventions to engage teenagers' curiosity to find out more about energy and to support them to learn about and save on their personal energy consumption. These objectives encompass both direct (electricity and fuel) and indirect (products and services) energy consumption. It is important that the learning experience is personalised and embedded in teenagers' everyday contexts. To achieve this we employ a design methodology that identifies teenagers' circumstances, including their knowledge, concerns and motivations, and models the connections between the multiple influences within teenagers' contexts. The Ecology of Resources design framework (Luckin, 2010) offers a process for working with participants that models and takes account of their context.

The EoR framework is inspired by a sociocultural philosophy of understanding and supporting learning (Vygotsky, 1978, 1986) and the notion of scaffolding, which defines the process of providing support that is closely contingent on the learner's current understanding and skills (Luckin et al., 2011; Pea, 2004; Wood, Bruner, & Ross, 1976). The EoR provides a method for designing learning technology and/or the use of learning technology, that considers the important relationship between the learner in their context, and the learning that arises out of interactions with their context. The EoR conceptualizes a learner's context in terms of their interactions with the many resources of their world, for example, with the people, places, books, knowledge concepts and technologies they encounter; and in terms of their personal resources, such as their motivation and existing understanding. In order to support learning, the EoR design process seeks to effectively link the world resources that are most appropriate for a specific learning goal and to scaffold interactions between these resources and the learner.

The EoR provides a process through which we first identify the world resources available to the learner and the processes and relationships that shape the learner's access to these. We also build an understanding of the learner and what they bring to the learning experience: their personal resources. The EoR also introduces the notion of filters to describe the artefacts that constrain a learner's access to resources, such as rules, regulations or physical and social boundaries or expectations. Having mapped out the learner's context, we begin an iterative, participatory process of design with the aim of developing technology that facilitates access to appropriate resources at appropriate times during the learning process. The EoR has been used with learners and teachers across a range of subjects, including science and language learning to design technology-rich learning activities and technology applications, such as Smartphone apps (Underwood, Luckin, & Winters, 2011).

2.1. The design framework

The EoR design process is structured in three phases that take a learner's wider context into account (see Luckin, 2010 for framework detail). These are:

2.1.1. Phase 1

Create an Ecology of Resources Model to identify and organize potential resources for learning. Six iterative steps support the modelling process, in which some steps will require several iterations. Step 2 is of particular importance and can necessitate several iterations through other steps. The steps in Phase 1 of the EoR and the associated research questions regarding teenagers' conceptions of energy consumption are:

Step 1 – brainstorming potential world resources.

a. What are the circumstances in which teenagers consume energy?
b. What energy consumption is most relevant to them?
c. What are their sources of information about energy consumption and energy sustainability?

Step 2 – specifying the focus of attention. This is informed by three elements: a) the current body of knowledge about energy consumption and energy sustainability issues, derived from the literature, b) the energy consumption that is relevant to teenagers (Step 1 of Phase 1), and c) teenage learners' current understanding about energy consumption and energy sustainability (Step 5 of Phase 1). The EoR design process is iterative. Step 2 emerges gradually through the entirety of the empirical work in Phase 1.

Step 3 – Categorizing World Resource Elements. Categorise World Resource Elements from Step 1 into: Knowledge and Skills, People and Tools, Environment.