Preface

"Learner Centred Methods for Designing Intelligent Learning Environments" Special Issue of the IJAIED

This special edition of the International Journal of Artificial Intelligence in Education invited papers that tackle the development and use of learner-centred methods for designing Intelligent Learning Environments. Learner Centred Design (LCD) methods are those that involve learners and other educational stakeholders in the development of the educational technology that is being designed to meet their needs. For members of the Artificial Intelligence in Education or AIED community the development of such technology also involves the use of techniques from Artificial Intelligence to provide adaptive system features.

This collection of papers recognises the evolution of the LCD approach from its roots in the work of those whose focus was upon human computer interaction (Benford et al., 1999; Druin, Bederson, & Hourcade, 2001; Rogers et al., 2004; Scaife & Rogers, 1998 for example) to those who are concerned with the development of adaptive educational systems. The need to take the views of system users into account and of the value of participatory methods such as LCD is now widely acknowledged. In short, the field of LCD has progressed a great deal from the early articles of the 1990s (ACM, 1996; Soloway et al., 1994), both in terms of what the phrase LCD encompasses and in the wide range of tools and techniques that have been developed to engage learners and stakeholders at a variety of different points in the design process. The paper by Good and Robertson in this collection outlines a brief history of the field of LCD and discusses the way this definition has evolved and the nature of its methods. The LCD approach has also involved new groups of professionals in the design of AIED systems, for example practitioners who bring skills and knowledge from other design cultures such as television and film. The papers by Luckin and Good in this collection provide examples of such collaborations.

In addition to offering the reader a snapshot of the current "state of play" with respect to the field of LCD for AIED systems, this volume also provides practical information about the LCD approach. The papers are grounded in LCD methods that can be used with a diverse range of learners involved in the study of many different subjects. The flexibility and versatility of the approach is evidenced for example through the range of roles user groups play, the variety of user group configurations including individuals and groups of different sizes, and the range of points within the design process at which users can be involved. Within this collection there are examples of a variety of tools in action. These include questionnaires; exposure to, and engagement with, prototypes from paper low-fidelity to semi functional and fully functional hi-fidelity systems; workshops; focus groups; Classroom Discussion Forums (CDFs); Wizard of Oz studies; scenarios and storyboards. Similarly the papers illustrate the use of a variety of data analysis techniques.

The papers in this collection have a particular emphasis upon working with young learners, who present a particular challenge for LCD methods. Children as designers are generally less able to express their thoughts and ideas than adults, and it is hard to gauge how the design tasks planned might work and the extent to which children can fully understand what they are required to do. Within the papers in this collection questions about the most appropriate ways to engage children in the design process and the nature of the limits on the usefulness of their contributions are explored.

The advantages of the LCD approach for the design of systems that work for users are becoming clear. As evaluation has become increasingly important for the AIED community, and as the development of learner models has moved beyond the purely cognitive to include affective issues such as motivation and confidence, learner-centred design methods can be employed to ensure that adaptive systems meet learners' needs. The paper by Hall, Woods and Aylett illustrates how the LCD process methods can be used to engage young learners in the design of a system that tackles the sensitive and important issue of bullying. The authors discuss the techniques they found effective and highlight the results that can be gained by using such techniques.

The involvement of learners in the design process is particularly important at a time when the existence of pervasive and ubiquitous technology combined with increased user sophistication and expectation is leading to a community of learners who can now appropriate technology to meet their needs in ways previously unanticipated by designers. We need methods that can help us to build better, more effective learner models that can inform the behaviour of systems that enable learning to take place across multiple locations. The paper by Luckin, Underwood, du Boulay, Holmberg, Kerawalla, O'Connor, Smith and Tunley in this issue starts to tackle some of these challenges.

There are of course also challenges and costs associated with the LCD approach. It is labour intensive and can only be implemented within the constraints of the participants' working environment. These constraints include physical constraints such as space, time constraints such as those associated with a school timetable, cultural constraints from individual classrooms, homes and institutions through to the political policy makers of the day. Learner consultation throughout the design process has resource implications for any research project, and these must be taken into account at the outset. Clear examples of how these issues impacted upon the projects at the heart of the papers presented here are included. Similarly the challenges of the iterative design process are illustrated, when on some occasions suggestions from the learner-designers may diverge substantially from the remit of the original research project. The papers in this collection illustrate the types of techniques that have been used effectively for managing the integration of ideas from different stakeholders in the design process, including learners, educationalists, researchers and software developers.

Each of the papers in this collection offers some key findings and indicates potential future directions. For Hall, Woods and Aylett the focus of their work was upon finding approaches that would enable them to gain children's input into a multidisciplinary project whose goal was the design and development of a system called FearNot! that used animated agents to act out bullying scenarios. Their paper offers a clear view about the advantages, disadvantages and practical implications of a range of techniques. They report on the use of Classroom Discussion Forums (CDFs) that enabled them to gather detailed information about children's attitudes towards bullying behaviour. This method was found to benefit both children and teachers who felt it enabled them to express their ideas in a non-threatening, familiar environment. Storyboarding on the other hand was found to be effective for developing appropriate language for bullying scenarios, detailed bullying character profiles, storyline design and progression, and for an exploration of empathy with respect to the creation of believable and engaging VLEs. The authors also highlight the value of Wizard of Oz techniques to supplement storyboards. As well as reporting on the use of recognised LCD techniques, this paper also introduces the trailer approach. This is the use of a snapshot of the final product, which the team found allowed children to gain an overview of the FearNot! system so that the team could verify its look and feel. Hall, Woods and Aylett are clear that their participants enjoyed the design process and gave the design team invaluable input to

the design process. For them, the LCD approach resulted in "an engaging application that children enjoy using and that they view positively."

Luckin, Underwood, du Boulay, Holmberg, Kerawalla, O'Connor, Smith and Tunley report on the design of the HOMEWORK system that is both underpinned by a learner model and that uses a combination of technologies that take interaction beyond the standard desktop. They take the reader through the iterations that moved their system from its initial design vision, as exemplified in a scenario, to a semi functional prototype that involved children, parents and teachers using technology in the school, in the home and in between. The authors illustrate how their system vision evolved with input from their user groups and point out the way in which the participatory design methodology led to a system that used AI techniques in a manner that was not that initially anticipated by the design team. The authors discuss the participatory techniques that worked in the classroom and those that worked in the home. In particular, their paper demonstrates the challenges of collecting data about user interactions with the system once it is out of sight of researchers and teachers. They describe the range of data sources collected in order to triangulate analysis and ensure rigour. Their use of logging techniques to find out how their software was used out of the classroom represents an area of increasing interest for the AIED community as it develops more mobile educational systems. This will surely be one of the challenges to be addressed as the LCD approach to AIED systems progresses. Luckin et al also illustrate how stakeholders helped to develop a system that links multiple learning locations into a single context through a focus upon coherent learning activities. These activities were developed with input from their users so that the relationship between the elements of the activity completed in the different locations is made explicit.

Good and Robertson propose a framework for learner centred design in which context, activities, roles, stakeholders and skills involved in the development of an educational system for children are considered (CARSS). It outlines a comprehensive set of issues which future developers of interactive learning environments may wish to consider at the outset of a project to guide their choice of appropriate learner-centred design techniques. The paper considers the constraints placed on user consultation by the settings in which such a project might take place, particularly in schools, and draws attention to the ethical issues involved in working with children. Design activities which are appropriate at various stages of the development life cycle are suggested with reference to previous projects described in the literature. The authors also consider the roles which can be adopted by individuals within a project to represent the perspective of stakeholder groups. A particular contribution of the paper is to consider the skills and dispositions required by both adults and children who are involved in design work. It outlines a core set of basic skills which are required of children such that they can contribute successfully to the project and points out that children below a certain stage of development may find it difficult to function effectively in a design team. Similarly, it describes the set of skills adult team members require, particularly in the role of facilitator. Good and Robertson present two case studies to illustrate CARSS, one which documents the design process of an intelligent tutoring system with a research focus, and another which charts the development of components of a publicly funded web-based learning resource.

Goolnik, Robertson and Good report on a learner-centred design methodology used in the development of a visual representation of interactive stories aimed at 10-12 year old children. The authors evaluated lo- and hi-tech versions of the visual representation with children in the target age group to ensure that the learners could both comprehend and generate representations of this sort. The authors comment that it is beneficial to iteratively evaluate designs with learners in cases where the domain is not likely to be familiar to learners, or where a complex representation is used to support learning. This avoids committing development effort to an interface which users find misleading, incomprehensible or difficult to use. The paper also addresses the issue of the circumstances under which it is suitable to involve children as equal

design partners (as proposed by Druin, 2002). In this particular project children were helpful in evaluating early designs but it would have been less effective to ask for their help in designing a complex visual representation. The authors make the general point that children are unlikely to be able to help in the design of representations for a new or complex domain with which they are unfamiliar, nor will they have much insight into the development of sophisticated techniques in developing adaptive systems. They recommend that in involving children in the design process of adaptive learning environments, researchers should be realistic about their potential contribution, but noting that "including learners, teachers and other stakeholders as informants and testers is invaluable if we are to produce high quality intelligent learning environments".

Rose Luckin

Judy Robertson

REFERENCES

ACM (1996). *Communications of the ACM*, 39(4).

Benford, S., Bederson, B., Akesson., K., Bayon, V., Druin, D., Hansson, P., Hourcade, J., Ingram, R., Neale, H., O'Malley, C., Simsarian, K., Stanton, D., Sundblad, Y., & Taxen, G. (1999). Designing Storytelling Technologies to Encourage Collaboration Between Young Children. In *Proceedings of CHI 2000* (pp. 556-563). New York: ACM.

Druin, A., Bederson, B., & Hourcade, J.P. (2001). Designing a Digital Library for Young Children: An Intergenerational Partnership. In *Proceedings of ACM/IEEE Joint Conference on Digital Libraries (JCDL)* (pp. 398-405). Virginia, June 2001.

Druin, A. (2002). The Role of Children in the Design of New Technology. *Behaviour and Information Technology*, 21(1), 1-25.

Luckin, R., Underwood, J., du Boulay, B., Holmberg, J., & Tunley, H. (2004). The NINF and the teacher: exploring teachers' views of the role of narrative in lesson planning. In Proceedings of International Conference on Narrative in Interactive Learning Environments. Edinburgh, Scotland, 2004.

Robertson, J. (2002). Experiences of Child Centred Design in the StoryStation Project. In M. Bekker, P. Markopoulos & M. Kersten-Tsikalkina (Eds.) *Interaction Design and Children 2002*. Shaker.

Rogers, Y., Price, S., Fitzpatrick, G., Fleck, R., Harris, E., Smith, H., Randell, C., Muller, H., O'Malley, C., Stanton, D., Thompson, M., & Weal, M. J. (2004). Ambient Wood: Designing New Forms of Digital Augmentation for Learning Outdoors. In A. Druin, J. P. Hourcade & S. Kollet (Eds.) *Interaction Design and Children 2004: Building a Community* (pp. 1-9). ACM Press.

Scaife, M., & Rogers, Y. (1998). Kids as informants: telling us what we didn't know or confirming what we knew already? In A. Druin (Ed.) *The Design Of Children's Technology: How We Design, What We Design, And Why.* Morgan Kaufman Publishers: San Francisco.

Soloway, E., Guzdial, M., & Hay, K. E. (1994). Learner-centered design: The challenge for HCI in the 21st century. *Interactions*, 1(2), 36-48.