Let me begin by thanking the editor of this fascinating volume for inviting me to contribute a foreword. A risky enterprise for him – I am emphatically not an expert in this field. And risky for me too: what might I bring that is useful?

I will start with the notion of adaptive learning, a theme that permeates many of the papers. What does adaptation mean, exactly? Who or what is adapting … and to whom? In scanning the contributions it seems an unproblematic question: the computer is adapting to the learner, assessing what she requires, when to provide it, and adapting – changing, altering, adjusting – in order to accommodate to those needs.

I use the word 'accommodate' deliberately. It was Piaget who pointed out that human learning can be thought of as adaptation, an ongoing process of organising experience. As is well known, the two major forms of adaptation are assimilation – in which new experiences are incorporated into existing cognitive structures – and accommodation, in which the elements of knowledge are restructured and reorganised to make sense of what is perceived and reflected upon. I guess that from the machine's point of view, both are involved, although I have the sense that – just like for humans – it is easier to assimilate information than to accommodate it.

I raise the Piagetian view of adaptation, because it is the clearest expression we have of the ways that learning actually occurs – at least on the individual level. The most important component of Piaget's theory is that learning involves equilibration, in which the learner strikes a balance between herself and her environment, between assimilation and accommodation. And it is this balance, a state of interaction between learner and environment in a constant state of flux to achieve dynamic equilibrium, that I think may be a useful metaphor for making sense of adaptation at the system level. The key point is that it may not always be helpful to think only of the organism adapting to the environment. On the contrary, it is important to try to understand how the environment is shaped by the learner's attempt to organise her experience of it.

This complexity of mutual interaction between learner and knowledge is one of the things that makes educational research so challenging. Educational researchers have learned the hard way that assessing the learning of 'knowledge' in computational environments is difficult precisely because what is to be learned is itself changed by being computationally based. A graph on a computer screen is not the same graph that one draws on paper; it is not simply a way (or two ways) of 'representing' knowledge, it is two different kinds of knowledge that point to two ways of viewing, say, a function and two sets of connections to (possibly) very different concepts. Given the infinite malleability of the computer – what Papert calls its "Protean" quality – this problem is very great indeed, and evaluating the efficacy of adaptation calls for novel and as yet untested methodological approaches.

This complexity is only compounded by the widespread acknowledgment that learning of all but the most elementary kinds of knowledge is best considered as a social, as well as a psychological phenomenon. What a person knows, how she comes to know it, and why are crucial aspects of the learning process, and certainly not adequately thought of – as

was sometimes the case in the recent past – as a 'social' context grafted on to an essentially individual development. Relatedly, and perhaps most importantly, it is activities and activity structures that are the most crucial element of formal learning, whether those activities are mediated by a teacher, by a computer or by a computer-teacher. In this respect, finding the right grain size and focus of activities to address the required learning is at least as important as finding the right ways to adapt to what the learner knows (or does).

Before I leave the question of adaptation, I would like to point to one important – and relatively newly-established – strand of educational research that might be helpful. We know, I think, enough to state unequivocally that only certain types of learning (such as the acquisition of simple facts or the practice of routine procedures) can ever attempt to cast the computer invisibly, a tool whose functioning is transparent to the learner. On the contrary, uses of computational systems that involve construction – building models of systems, for example – necessitate a process of what French researchers have called 'instrumentation': for any given individual, the computational artefact only becomes an 'instrument' – a useful and expressive tool – through a process of *transformation* in two different directions. First, by endowing the tool with potential and actual uses; and second, by the tool 'transforming' the individual, so that she can respond with the tool to tasks in hand. This is an unexpected complexity, in which tool and individual are reciprocally shaped, and it explains why the design of activities is so critical.

I cannot end without a word about 'personalisation'. It is, as every UK-reader will know, the political theme of the moment. Quite what the politicians mean by personalisation is far from clear: sometimes 'personalisation' and 'choice' appear as synonyms as if rather difficult challenges (such as how choices are allocated) do not exist. Similarly, the Department for Education and Skills website informs us that personalised learning "has the potential to make every young person's learning experience stretching, creative, fun and successful". It would, of course, be fine if that potential was realised, although it is far from clear what role – if any – is actually envisaged for digital technologies in this scheme. Nevertheless, whatever personalisation comes to mean, and whatever roles the computer is asked to play in the process, I simply want to strike a realistic note in favour of educational (not simply technical) research. As I hope I've made clear, there are real methodological challenges that have to be faced, and they are multi-disciplinary ones that will necessitate crossing boundaries between computer science and social science, as well as between sub-fields within this broad classification.

This is a timely book that will communicate a range of important ideas on the personalisation of web-based learning environments to a wide international audience. It provides an introduction to some basic ideas for those who are curious about the field, as well as covering more advanced theoretical, methodological and practical issues. Congratulations to the contributors and editors of this volume for carrying this project forward.

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