

Swarm-Based Adaptation: Wayfinding Support for Lifelong Learners

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Abstract. This article introduces an approach to adaptive wayfinding support for lifelong learners based on self-organisation theory. It describes an architecture which supports the recording, processing and presentation of collective learner behaviour designed to create a feedback loop informing learners of successful paths towards the attainment of their learning objectives. The approach is presented as an alternative to methods of achieving adaptation in hypermedia-based learning environments which involve learner modelling.

1 Introduction

Self-direction – the learner’s assumption of “primary responsibility for and control over decisions about planning, implementing and evaluating the learning experience” [1] – lies at the heart of lifelong learning. However, self-directed learners are often challenged to assume responsibilities, and the self-directed learner may be “confronted with the problem of how to find a way into and through a body of knowledge that is unknown at the outset. Without the benefit of any explicit guidance, a self-directed learner is obliged to map out a course of inquiry that seems appropriate, but that may involve a certain amount of difficulty and disappointment that could have been averted” [2]. This description calls to mind the image of the lifelong learner as navigator, charting a course through educational waters. We follow Darken [3] in using the term “wayfinding” to describe the cognitive, decision-making navigational process carried out by self-directed learners as they assume responsibility for sequencing their learning interactions *en route* to the attainment of certain competencies. Fixed curricula serve only to restrict the possibilities for self-direction – lifelong learners need a flexible, adaptive approach to wayfinding support (termed adaptive navigation support by Brusilovsky [4]), able to respond to their changing situations and goals.

2 Wayfinding Support for Lifelong Learners

Flexibility in wayfinding support can be realised through so-called “learner support services” [5]. However, individualised advice is costly. As a response to this financial

* The authors wish to thank Wim Waterink, Catherine Bolman and Pierre Höppener of The Open University of The Netherlands for their contributions to this work.

issue, research has explored the application of educational technologies to lifelong learning support. The authors of a recent CEDEFOP thematic workshop report [6] contend that Adaptive Hypermedia Systems (AHSs) are “particularly suited to implementing lifelong learning ... because they can tailor the learning environment and content to each individual learner’s needs and aptitudes”. AHS continues the Intelligent Tutoring Systems research line in seeking to “build a model of the goals, preferences and knowledge of the individual user and use this through the interaction for adaptation of the hypertext to the needs of the user” [7]. The reliance on accurate, detailed and up-to-date user models is both the theoretical strength of Adaptive Hypermedia and its practical Achilles heel. Without models, or with incorrect ones, adaptation falters, and Self [8] notes the absence of a theory of learning which might be used to maintain learner models. Is there, then, an alternative approach to wayfinding guidance for lifelong learners which might provide a cost-effective, flexible solution yet which does not rely upon learner modelling?

The ideal approach would avoid pre-planning of wayfinding guides so that courses, as it were, spontaneously acquire effective structures or organisations. Such self-organisation – “the acquiring of a spatial, temporal or functional structure without specific interference from the outside” [9] – can be seen in ant foraging trails [10]. Paths identified by ants are not pre-planned, but emerge as a result of indirect communication between members of an ant colony, a process known as stigmergy. In their overview article Theraulaz and Bonabeau [11] state, “The basic principle of stigmergy is extremely simple: Traces left and modifications made by individuals in their environment may feed back on them”. Stigmergy can be considered as the basis for an approach to wayfinding support for lifelong learners. We can imagine learners’ interactions with learning resources and activities being recorded automatically as they progress through a body of knowledge, then processed/aggregated and finally fed back to other learners. This would provide a new source of wayfinding guidance to lifelong learners giving clues as to efficient paths through a body of knowledge. Such an approach is cost-effective, since trail creation occurs unnoticed as a side effect of learner interaction with e-learning systems, it is flexible, able to emerge from and adapt to different circumstances, and it holds the prospect of being implementable, since its adaptivity does not depend upon learner modelling but rather on the behaviour of the “swarm” of learners.

3 An Architecture for Wayfinding Support in Lifelong Learning

Our work on wayfinding support is being carried out as part of the development of flexible lifelong learning facilities that meet the needs of learners at various levels of competence throughout their lives, which we term “Learning Networks” or LNs [12]. A Learning Network consists of learning events called Activity Nodes (ANs), such as courses, workshops, conferences, lessons, internet learning resources, etc.

In Learning Networks, the Learner’s Position is defined as the set of ANs already completed in the LN. The Learner’s Target is the set of ANs that is sufficient to reach a particular level of competence or expertise in the domain. These two concepts equate to “you are here” (position) and “there’s where I want to be” (target), and the wayfinding guidance which is fed back concerns effective ways of getting from here to there, based on the behaviour of the swarm of previous learners.