Learning Path Adaptation
in Online Learning Systems

Alva Muhammad[1], Qingguo Zhou[2], Ghassan Beydoun[1], Dongming Xu[3], Jun Shen[1]

1-School of Computing and Information Technology
University of Wollongong, Wollongong, NSW, Australia
Email: ahm145@uowmail.edu.au, beydoun@uow.edu.au, jshen@uow.edu.au

2- School of Information Science and Engineering
Lanzhou University, Lanzhou, China
Email: zhouqg@lzu.edu.cn

3-UQ Business School, The University of Queensland, Brisbane, Australia
Email: d.xu@business.uq.edu.au

Abstract—**Learning path in online learning systems refers to a sequence of learning objects which are designated to help the students in improving their knowledge or skill in particular subjects or degree courses. In this paper, we review the recent research on learning path adaptation to pursue two goals, first is to organize and analyze the parameter of adaptation in learning path; the second is to discuss the challenges in implementing learning path adaptation. The survey covers the state of the art and aims at providing a comprehensive introduction to the learning path adaptation for researchers and practitioners.**

Keywords—learning path, learning path adaptation, personalized e-learning, adaptive online learning system

I. INTRODUCTION

An adaptation of the online learning system has been researched extensively over the last decade in the various models. The purpose of adaptation is to optimize the relationship between the learning requirement and course content, hence, the learning outcome could be obtained with minimum time and interaction expended on a course [1]. Several types of adaptation, such as adaptation based on students' characteristics , learning style , and context history , are widely discussed in the literature and in several surveys [2-5].

In this paper, we investigate the adaptation based on learning resources (learning objects) and links between them, i.e., the learning path [3, 6]. A learning path is defined as a *sequence* of learning tasks or activities which are designated to

assist the student in improving their knowledge or skill in the particular subject [7]. The purpose of sequencing learning path is to provide learners with the most suitable individual learning object to learn according to the learner characteristics.

As an example, let us take two students John and Julia which are interested in learning Web Programming using a tutorial available from the online learning resources in their school. John has the basic foundation in algorithms, but he is interested in furthering his learning to programming. Meanwhile, Julia is a first year student without any prior relevant knowledge. John and Julia can have different learning paths to achieve the set proficiency target in web programming. Julia will likely require a longer learning path than John's learning path. It would be more appropriate to individualize their learning path to match their prior knowledge. This is the essence of adaptation of learning path based on the content, to enable students to reach their learning objectives quicker and matching their individualized learning path to their background and knowledge. Sequencing the components in a learning path accommodates the students and prepares the relevant knowledge units or learning activities required.

Providing an optimal learning path tailoring to the context of the learners is a crucial issue in online learning adaptation. An optimal learning path could reduce the student's cognitive overload and disorientation; consequently, this process would improve the student learning outcome and efficiency of the adaptation in the online learning systems [8, 9].

This paper presents a survey of learning path adaptation efforts in the web-based educational system from 2008 up to 2015. The survey highlights the significance of adopting a