

Authoring Adaptive 3D Virtual Learning Environments

The use of 3D (3 Dimensional) Virtual Environments is gaining interest in the context of academic discussions on E-learning technologies, as it provides several advantages over classical learning material. However, the use of 3D for learning environments also has drawbacks, especially usability and the effectiveness may cause problems. One way to overcome these drawbacks is by providing an *adaptive* 3D Virtual Learning Environment (3D VLE), i.e. an environment that dynamically adapts to the learner and the activities that he performs in the environment. However, developing adaptive 3D Virtual Learning Environments is not simple and should be supported.

In this thesis, we discuss adaptive 3D VLEs and explain how a course author can specify (i.e. author) such an environment. The authoring approach that we present allows authors to create adaptive 3D VLEs *without the need to be an expert in 3D and without using programming or scripting languages*. In particular, the thesis elaborates on *the principles used for the authoring approach*, as well as on *the different aspects that need to be supported*, i.e. the pedagogical aspects, the adaptation aspects, and *the requirement to support the specification of an adaptive storyline* which should be followed by learners.

Consequently, the main objectives of the research work are: (1) to investigate the possible adaptations that can be applied to 3D VLEs, in order to allow adapting a 3D VLE to the learner's knowledge, skills, and behaviour; and (2) to study how to facilitate the authoring process of adaptive 3D VLE for 3D novice educators.

To achieve these objectives, we first present *a generic conceptual modelling framework* for this type of systems. In addition to that, *a number of adaptation types and strategies* are proposed that authors can use for specifying adaptivity in 3D VLEs. Furthermore, *the concept of adaptation theme* is proposed to ease the specification of consistent adaptations for an adaptive 3D VLE. The research work also proposes *visual languages* specifically conceived *to allow authors to specify adaptivity in 3D VLEs*. Namely, the proposed visual languages are the Pedagogical Model Language, the Adaptive Storyline Language, and the Adaptive Topic Language. Each language is used to specify a different aspect of the conceptual modelling framework. Within this research work, we also conducted *an evaluation to the proposed visual languages*. In particular, the conducted evaluations aimed at validating both usability and acceptability aspects related to the proposed visual languages. Finally, we also propose *a prototype of authoring tool* for supporting the proposed authoring approach and the visual languages.

The findings presented in the thesis can be applied by software engineers to construct authoring tools for designing adaptive 3D VLEs. In addition, the findings can also be used for further research.