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Towards Personalised and Adaptive Learning Paths in Immersive Educational Environments

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Abstract. It has been considered that when creating a learning module in an immersive educational environment the learning design process is time consuming particularly dictating the rules responsible for sequencing the module's lessons. This challenge becomes more complicated when the sequence needs to be made more adaptive and personalised. Therefore, we introduce our proposed prototype system called iPerSeq –an intelligent Personalised Sequencing system-. This prototype relies on machine learning to intelligently personalise and adapt the learning path for individual students based on their previous contributions and behaviours during learning. This work in progress paper describes the current research being undertaken to investigate this issue and how it can be deployed in 3D Virtual Worlds. In addition, we explain the system's conceptual model.

Keywords. Adaptive course sequencing, immersive educational environment, adaptive educational systems, adaptive learning paths, Learning Design.

Introduction and related works

The use of immersive environments in educational field results in many possible advantages such as: 1) promoting the students' engagement, 2) visualising the learning objects that would be hard to understand in a 2D space [1][2]. There are numerous immersive educational environment proposed to achieve these. However, most of the proposals ignore the differences between students - which can contribute to the students' dissatisfactions. Adaptive educational systems try to overcome this issue by personalising the students' learning experience - often utilising machine learning. Hence, these systems observe students learning and collect the relevant information to extract rules used by pedagogical tutor agent.

To date, some research has been conducted to investigate the issues related to learning design and content sequencing in 3D environments[3]. Some researches explore how to make the sequence between learning activities more adaptive[4]. Our work focuses in solving this issue in 3D immersive environment. We propose a conceptual model for our prototype system (iPerSeq) which applies the adaptive learning path algorithms in 3D immersive educational environment. In an example scenario described below, the student will learn some lessons on Solar System module

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delivered in a 3D virtual space and iPerSeq adapts the sequence of the lessons for this module.

1. Our Proposed prototype (iPerSeq)

In the first use of iPerSeq, student will do a pre-assessment to measure his/her knowledge about the module. The pre-assessment mark will be stored in the student profile as well as other factors to make the decision about the most optimal learning path. In addition, iPerSeq has simple node-based module map. Every node presents one concept (e.g. the planets) and has one of three colours (blue, green and red), which indicates whether the student has opened this node yet, whether the student has achieved the relevant learning objective or not. Moreover, the learner will see the suggested learning paths as shown in Figure 1. Furthermore, every node holds the lesson's location in the immersive space and when the student chooses a node, the system will initiate transition to the lesson's location.

Figure 1: The node-based module map in iPerSeq

1.1. iPerSeq Models

From the earlier description we have proposed the model below.

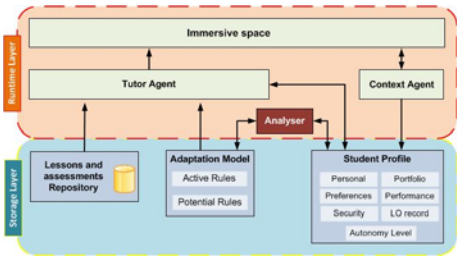

Figure 2. iPerSeq Conceptual Model

The model shown in **Error! Reference source not found.**Figure 2 is divided into two layers: the runtime layer and storage layer. The runtime layer is responsible for performing some adaptive functions and has these components: immersive space, tutor agent, context agent and analyser. The storage layer has these components: lessons and assessments repository, student profile and the adaptation model.

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1.1.1.1. Context Agent
This component is responsible for tracking the learner's behaviours and passes the information to the student profile.

1.1.1.2. Analyser
Once enough information is gathered about a student, the analyser, using machine learning, analyses student profiles and observes the patterns of the sequences that students have made in order to generate rules.

1.1.1.3. Adaptation model
The adaptation model contains sets of rules similar of this one (If the previous domain knowledge is poor AND the lesson A mark is good THEN next lesson is B) these rules are generated and refined over time by the analyser. iPerSeq should be trained before used to rich this model.

1.1.1.4. Tutor Agent
This component is the process manager. It guides the learner based on the student profile and the active rules. This agent measures the level of knowledge for the learner before and after leaning the course in general and every concept in specific to determine if the student needs a support.

2. Summary and Future work

As one of the early stages of our work-in-progress research, this paper present a possible way to apply the adaptive educational sequencing in a virtual reality learning environment to make learning path in these environments more adaptive and personalised. This work introduces the proposed conceptual model and a prototype system (iPerSeq) which will applies these models. It is hoped that the functionalities perceived will allow students to better personalise their learning experiences. In the future, we expect to further this work by making all the system's component work in real time (while students learning), investigate the ways of building affective adaptation model and student profile and the fuzzification of the interactive pedagogical space.

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