

UNIVERSITY OF TECHNOLOGY SYDNEY

**Believable Conversational Agents for Teaching  
Ancient History and Culture in 3D Virtual  
Worlds**

A thesis submitted for the degree of  
Master of Science in Computing Science

by

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## CERTIFICATE OF AUTHORSHIP/ORIGINALITY

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Signature of Candidate

*With gratitude to my parents -  
my guiding stars who introduced me to love, life and learning.*

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## ABSTRACT

This thesis introduces believable conversational agents as an engaging and motivational learning tool for teaching ancient history and culture in virtual worlds.

Traditional approaches are lacking engagement, interactivity and socialisation, features that are of tremendous importance to modern students (digital natives). At the same time, modern 3D visualisations primarily focus on the design side of the given space and neglect the actual inhabitants of these ancient places. As a consequence, in such historical or cultural 3D visualisations it is difficult to engage the students in the learning process and to keep track of students' learning progress. Furthermore, this approach neglects the knowledge carriers (inhabitants of the ancient site) which are an important part of a particular culture and played an important role in significant historical events.

Embodied conversational agents envisaged by this thesis for teaching ancient history and culture must be believable as they act in highly dynamic and heterogeneous environments such as 3D Virtual Worlds with both human and autonomous agent participants. In these virtual environments participants behave autonomously and frequently interact with each other and with software agents. Therefore, embodied conversational agents must know their surroundings, be aware of their own state in the virtual environment and possess a detailed knowledge of their own interactions as well as the interactions of other participants. We label such agent abilities as "awareness believability" and develop the necessary theoretical background and the formalisation of this concept. We also discuss the *I<sup>2</sup>B* (Interactive, Intelligent and Believable) framework that implements awareness believability using the combination of the Virtual Institutions technology, the AIML engine and the visualisation layer of Virtual Worlds.

Through a detailed literature review on virtual agents' believability we identified the ability to continuously learn new conversational skills as another important aspect of being believable. Thus, this thesis also explains how AIML specific rules and virtual agents' interactions with subject matter experts help to dynamically improve the conversational corpus of virtual agents via imitation learning.

To validate the impact of supplying agents with awareness believability we conducted a number of case studies specific to the domain of ancient history and culture. The studies confirmed that the identified awareness features are indeed making the agents perceived as more believable. Furthermore, the studies provide important evidence in favour of using virtual agents for improving the knowledge of students in the domain of ancient history and culture.