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Mobile Learning Ontologies:

Supporting Abductive Inquiry-Based Learning in the Sciences

A thesis presented in partial fulfilment of the requirements for the degree of

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To my parents for their love, endless support and encouragement!!

Abstract

The use of ontologies has become increasingly widespread in many application areas, particularly in technology-enhanced learning. They appear promising in supporting the generation and adaptive presentation of learning content for specific domains. This thesis examines how ontologies can be applied in abductive mobile science inquiry-based learning, an example of a learning activity that can allow students to learn science by doing science.

Traditionally, school science education has been dominated by deductive and inductive forms of inquiry investigations, while the abductive form of inquiry investigation has previously been sparsely explored in the literature, which emphasizes the development of scientific hypotheses from observed phenomena. Thus, this provides us with an opportunity to explore some new approaches to technology-assisted learning in the sciences.

The main purpose of this thesis is to demonstrate to science educators how an abductive mobile application may be applied in a science inquiry activity, and how ontology-based scaffolding can support technology-enhanced learning environments.

This thesis uses a Design Science Research Methodology (DSRM), supported by Activity-Oriented Design Methods (AODM) tools to create an ontology-driven application 'ThinknLearn' for a science inquiry domain, which has been evaluated using the M3 evaluation framework with high school science students. The results were promising and showed improvements in the students' understanding of the learning domain as well as developing their positive attitudes towards mobile learning.

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List of Publications

- ❖ **Ahmed, S., & Parsons, D.** (2013). Abductive Science Inquiry Using Mobile Devices in the Classroom. *Computers & Education*, 63, 62-72.
- ❖ **Ahmed, S., & Parsons, D.** (in press). Abductive science inquiry using technology-enhanced learning. In J. Jovanovic, & R. Chiong (Eds.), *Technology Enhanced Learning*. Santa Rosa, California: Information Science Press.
- ❖ **Ahmed, S., & Parsons, D. (Best paper award)** (2012). Evaluating 'ThinknLearn': A mobile science inquiry-based learning application in practice. *11th World Conference on Mobile and Contextual Learning (MLearn 2012)*. Helsinki, Finland.
- ❖ **Ahmed, S., Parsons, D., & Mentis, M.** (2012). Scaffolding in mobile science enquiry-based learning using ontologies. *ICST Transactions on e-Education and e-Learning Journal*, 12(07-09), 1-17.
- ❖ **Ahmed, S., Parsons, D., & Mentis, M.** (2012). An ontology supported abductive mobile enquiry based learning application. *In proceedings of the IEEE International Conference on Advanced Learning Technologies (ICALT 2012)*. Rome, Italy.
- ❖ **Ahmed, S., & Parsons, D.** (2011). ThinknLearn: An ontology-driven mobile web application for science enquiry based learning. *In Proceedings of the 7th International Conference on Information Technology and Application (ICITA 2011)* (pp. 255-260). Sydney, Australia: IEEE Computer Chapter NSW.

- ❖ **Ahmed, S.,** & Parsons, D. (2011). COMET: Context Ontology for Mobile Education. In G. Biswas, S. Bull, J. Kay, & A. Mitrovic (Eds.), *Artificial Intelligence in Education (AIED 2011)* (Vols.LNAI 6738, pp.414-416). Springer-Verlag Berlin-Heidelberg.
- ❖ **Ahmed, S.,** Parsons, D., & Ryu, H. (2010). Supporting adaptive learning interactions with ontologies. *In Proceedings of 11th Annual ACM SIGCHI NZ Conference on Computer-Human Interaction (CHINZ 2010)* (pp. 17-24). Auckland, New Zealand.
- ❖ **Ahmed, S.,** Parsons, D. and Ryu, H. (2010). Beyond learning objects - Dynamic adaptation in learning scenarios for lifelong learners. *IEEE Learning Technology Newsletter, 12(1)*, January 2010, 49-51.

List of Acronyms

AIM	Abductive Inquiry Model
AODM	Activity Oriented Design Methods
API	Application Programming Interface
AT	Activity Theory
DL	Description Logics
DSRM	Design Science Research Methodology
DTD	Data Type Definitions
HTTP	Hypertext Transfer Protocol
IBL	Inquiry-based Learning
JSP	Java Server Pages
LO	Learning Objects
MCQs	Multiple Choice Questions
NCEA	National Certificate of Educational Achievement
OWL	Web Ontology Language
PBL	Problem-based Learning
RDF	Resource Description Framework
RDF-S	Resource Description Framework Schema

TEL	Technology-Enhanced Learning
W3C	World Wide Web Consortium
XML	Extensible Mark-up Language

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