

Chapter 6

A Petri Net Model for Analysing E-Learning and Learning Difficulties

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ABSTRACT

Petri Nets are tools for the modelling and analysis of the behaviour of systems and analysis of the Petri Net can then reveal important information about the structure and dynamic behaviour of the modelled system. In this article, the author argues that Petri Net concepts (when used qualitatively) are not fundamentally different from those of ANT. For example, the 'places' from Petri Nets bear a strong resemblance to the actors in ANT, and the 'triggers' or 'transitions', are somewhat analogous to ANT's translations. In modelling, places represent conditions and transitions represent events. Tokens may model the resources or data items that are associated with a place or places. The original research that this article is based on was undertaken using an actor-network framework to develop a model for e-Learning for students with Learning Difficulties. This article explores the qualitative use of Petri Nets to supplement this ANT treatment.

SOCIO-TECHNICAL RESEARCH ON STUDENTS WITH LEARNING DIFFICULTIES (LD)

Students with Learning Difficulties (LD) are catered for in Australia in both 'main stream' schools and in Special Schools. There are over 100 'Special Needs' Schools in Victoria and over 1,200 in Australia to provide education for students with various learning difficulties (learning difficulties/disabilities of general nature, intellectual or

physical) that fall into several categories ranging from mild to physical and severe learning difficulties. Table 1 shows the various categories of LD that can be found in the directory of special needs schools.

A useful definition of LD comes from the Learning Disabilities Association of Canada (LDAC) who defines LD as:

A number of disorders which may affect the acquisition, organization, retention, understanding or use of verbal or nonverbal information. These

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disorders affect learning in individuals who otherwise demonstrate at least average abilities essential for thinking and/or reasoning. As such, learning disabilities are distinct from global intellectual deficiency. (Learning Disabilities Association of Canada, 2002)

ANT AND STUDENTS WITH LD

Special Schools are complex socio-technical entities and research into their curriculum needs to take account of this complexity. The actors involved in the adoption of this technology to assist students with special needs include: students, parents, teachers, school principals, school ICT specialist teachers, the School Council, the Web, computers, Education Department policies, learning technology policy, the school environment, classroom environments, learning approaches and paradigms, delivery methods of instruction, engagement methods, thinking processes, technology infrastructure-bandwidth, curriculum, Internet resources, digital libraries and other schools. In an ANT framework, actors are seen to contest and negotiate with each other in an attempt to influence the final outcome in a direction to their own liking. The Education Department, for example, might want ensure that all schools offer a similar level of service to students and to ensure their accountability. The parents of a student with LD, on the other hand, would want the best for their own child regardless of what was going on in other schools.

A BRIEF INTRODUCTION TO PETRI NETS

Petri Nets were invented in the late 1930s by Carl Adam Petri (1962), and in simple terms these are graphical objects with arcs and transitions. He and Lee (2007) applied Petri Nets to model e-learning platforms or environments. Other studies concentrate on the semantic aspects of e-learning

(Ghaleb et al., 2006) and Park and Kim (2008) have analysed the different layers for e-learning and recommended the modelling with a suitable Petri Net. A full mathematical treatment of Petri Nets is beyond the scope of this article but here is provided a discussion of the basic concepts that are fundamental to the model design. In the article I will argue that although Petri Nets are often used as a tool in quantitative research, they also have a place in qualitative research and especially socio-technical research. The chief attraction of this approach is the way in which the basic aspects of distributed systems are identified conceptually and mathematically, and hence, it is most appropriate to build a model for e-learning on this basis.

According to Petersen (1981), the guiding principles of Petri Net theory in formulating the basic notions of states and change of states (called transitions) are:

1. States and transitions are two intertwined but distinct notions that describe an even handed treatment.
2. Both states and transitions are distributed entities.

Table 1. Summary of special needs categories (adapted from Australian Schools Directory, 2011)

Special Need Category	
General Disabilities	Intellectual Disabilities/ Autism
Hearing Impaired	Learning Difficulties
English Learning	Moderate to High Needs
Distance Education	Multiple Disabilities
Autistic	Physical Disabilities
Emotional Behaviour	Speech / Language Disorders
High Needs	Vision Impaired
Intellectual Disabilities	Young Mothers

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