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Design of a Scrutable Learning System

By

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Abstract

FACULTY OF PHYSICAL SCIENCE AND ENGINEERING

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Personal Learning Environments (PLEs) refer to systems that allow individual learners to manage and control their own learning in their own space and at their own pace. In this work we explore the different ways in which a learning experience can be informal, and propose a 4D model of informal learning to characterise the informal aspects of a learning experience.

The model includes dimensions for learning objectives, the learning environment, learning activities and learning tools, and reveals how much of the experience is really under the control of the learner. In an analysis of mobile tools presented in the mLearn 2008 conference we show that many emerging m-learning systems focused on informality in the environment dimension but not in the others.

To solve this problem this report proposes a scrutable learning model approach that allows personal learners to take control of their learning objectives while still allowing the system to intelligently support them with appropriate learning activities and resources. In addition an experimental design is described based around a prototype of a scrutable learning system for mobile devices.

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Definitions and Abbreviations Used

PLEs Personal Learning Environments
VLEs Virtual Learning Environments
AHS Adaptive Hypermedia System
ITS Intelligent Tutoring Systems
EML Educational Modelling Language
SCORM Sharable Content Objective Reference Model
SKOS Simple Knowledge Organisation System
IMS LD IMS Learning Design
IMS SS IMS Simple Sequence IMS CP
IMS Content Packaging
ICT Information and Communication Technology
OWL Web Ontology Language
RDF Resource Description Framework
RDFS Resources Description Framework Schema

Chapter 1 Introduction

1.1 Introduction

Personal Learning Environments (PLEs) are systems that allow individual learners to manage and control their own learning using their own mix of (often third party) tools (Wilson et al., 2006). Because of the level of independence that they grant to a learner they are often associated with mobile and informal learning. However, it is not clear in what ways existing mobile learning systems are informal, so in this work we proposed a 4D model of informal learning that can be used to analyse and review the informal aspects of a learning experience, and used it to examine a number of mobile personal learning tools and systems (Chen, Millard et al., 2008 A).

The model includes dimensions for learning objectives, learning environment, learning activities and learning tools, and reveals how much of the experience is really under the control of the learner. In an analysis of mobile tools presented in the mLearn 2007 conference we show that many emerging m-learning systems focus on informality in the environment dimension (they allow students to use them where and when they liked) but not in the others, therefore although it is claimed that these kinds of systems support personalised learning, the reality is somewhat more mixed, with little student choice and control of learning objectives and activities (Chen, Millard et al., 2008 B).

This may be because it is a challenging for personal learning systems to support learning in a more structured way without students losing the flexibility and control that characterised them as personal learning in the first place. But flexible yet structured support is exactly what is needed to enable adaptive and personalized learning systems that can solve the one-size-fits-all problem that arises in conventional educational technology. For example Adaptive Educational Hypertext (AEH) systems such as AHA! (De Bra, Aerts et al., 2003) and The Personal Reader (Dolog, Henze et al., 2004) employ a user model to record interaction between the system and users, to model their evolving knowledge and skills, and then to present content to them through adapted navigation and presentation.

A similar problem of system intelligence verses user control has already been faced in the more general Adaptive Hypermedia literature, when users cannot control the adaptation process (and therefore cannot correct it when it goes wrong). One solution proposed in that case is to allow scrutable user models that can be examined and changed by the user (Kyriacou, 2008).

This research proposes to apply the same principle to learning models, in order to allow them to be used in a system while retaining the spirit of personal learning. We believe that a scrutable learning model would allow personal learners to make informed decisions about their learning objectives while still allowing the system to intelligently support them with appropriated learning activities and resources.

This research proposes a simple AEH system that uses a learning model that is composed of two parts, a subject domain modeled in Simple Knowledge Organization System (SKOS) and a collection of alternative learning paths through that domain (modeled using IMS Simple Sequencing). By making these models scrutable, we believe that we will allow user to take advantage of the adaptation and guidance, while retaining the feeling of control and choice expected in a PLE.

A scrutable model refers to a model that is capable of being understood by showing independent learners the intention or goals behind a given learning activity, instead of merely guiding them thorough the journey. A scrutable model may only be partially visible to users, i.e. they would understand how it works and why. In other words, they can partially see through it, i.e. they can understand and see parts of the model, but more complex parts (that would not be helpful to them) remain hidden.

The scenario below shows how a scrutable learning model could work:

Scenario:

Maria has decided that she would like to be healthier, and wants to use a mobile coaching system to learn about a healthy lifestyle. The system she uses is designed with a learning model which is scrutable by showing her the intention behind given learning tasks and possible learning paths.

For example, one day the system recommends that Maria go swimming, using a visualisation support tool such as a concept map she discovers that this is part of learning about aerobic training and enhancing breathing capacity.

However, Maria is not fond of the water so she uses the tool to find a suitable replacement activity such as running.

Using the scrutable system Maria can freely make informed decisions about her learning objectives, rearranging the given learning activities in her own way towards her desired learning outcome whilst understanding the meaning behind the given learning activities. Then appropriate learning resources and corresponding support activities are given from the system to scaffold the learning process

Through the learning model, she can freely monitor her progress and get a better understanding of what to do and how to do it better with the advice provided by the system, feeling in control of the entire learning process.

The contributions made in this document are as follows:

- A 4D model of informal learning – which is a framework presented at m-learn conference 2008 and ICCE 2008 conference for exploring the formality of both existing e-learning and mobile learning systems. More details are shown in Chapter4.
- Analysis of existing m-learning tools – which analyses whether existing m-learning tools are in the spirit of a mobile PLE or a mobile VLE. More details can be found in Chapter 4.
- A Scrutable learning model- which helps understand how a learning process can be guided with a given subject domain and possible learning paths. More details are presented in Chapter 5.
- Expert review of appropriateness of SKOS and IMS Simple Sequencing (SS) – which was running with the objectives of exploring whether the SKOS data model can be used as a concept mapping tool for learning how to learn and further providing a learning approach to self-directed learning, and whether IMS SS can provide an optimization learning path to the self-directed learning. More details will be addressed in Chapter 5.
- A proposed design for a scrutable system using the SKOS and IMS SS. More details are presented in Chapter 6.

1.2 Report Structure

After **Chapter 1**, this report has been organized as follows:

Chapter 2 reviews how learning-related theories underpin educational strategies and pedagogical design, and explores the formality of learning in terms of the context.

Chapter 3 explores different approaches to building e-learning systems and investigates whether these can be described as supporting informal or self-learning.

Chapters 4 proposed a framework relevant to formality of learning for exploring whether current e-learning or mobile learning systems are in the spirit of a PLE or a VLE.

Chapter 5 explores the potential approaches to providing scrutable models, and a case study of modelling in IMS SS and SKOS

Chapter 6 presents the design of a system with a scrutable learning model

Chapter 7 concludes the report and proposes future work.

Chapter 2 Personal Learning

2.1 Introduction

A variety of learning-related theories are often employed to underpin the design and use of different pedagogical strategies for different purposes of learning, in different learning contexts. For example, social constructivism is concerned with building on someone's existing knowledge in a social context, such as collaborative group work.

In this chapter we will explore how these learning-related theories are employed to underpin and support the design of different learning activities covering both formal and informal learning.

2.2 Learning Theories

Learning theory is applied to explain what happens when learning takes place (Swann, 1999). *"The adoption of different learning theories results in different foci on educational and learning outcomes, and different instructional approaches should be appropriated to support these intended outcomes"* (Chen Der-Thanq, 2007). The following sections give a brief discussion to each of their framework. Learning theories include Behaviourism, Cognitivism, and Constructivism (Mergel, 1998).

2.2.1 Behaviourism

From the perspectives of behaviourism, the main focus is on behaviour, the impact of external world in shaping the individual's behaviour and change in behaviours which can be observed and measured (Good and Brophy, 1990). *"Learning is inferred from behaviour, identifying the goal behaviour and breaking that goal behaviour into a set of simple behaviours and arranging them in a sequence of frames that will help students progress towards the goal"* (Baruque and Melo, 2004).

Behaviourists such as Pavlov, Watson, Thorndike and Skinner (Mergel, 1998), have an attempt at eliciting the desired response from the learner with a presented target stimulus. Therefore response and stimulus play an important role in the developmental process of reinforcement of learning.

2.2.2 Cognitivism

Cognitivism stresses the concepts of how to help learners organise new information and then relate it to existing knowledge in memory (Mergel, 1998). In addition, it also emphasises the internal mental structures, and knowledge acquisition, including conceptualising the learning processes of learners and accommodating how information can be further handled via a series of process consisting of information receiving, organising, analysing, transferring, restoring and retrieving (Good and Brophy, 1990, Cofer, 1971, Wittrock, Marks, and Doctorow, 1975).

From the viewpoint of cognitivism, the design of course is more flexible with ideas of continuous assessment, group-based learning and applied practice, being integrated into the learning experience.

2.2.3 Constructivism

The view of constructivism is that learning is constructed by the complex interplay among students´ existing knowledge, the social context and the problem to be solved (Baruque, Porto et al., 2003). Merrill (1991) asserts that (a) knowledge is constructed from experience, and (b) learning is a personal interpretation of the world and (c) an active process in which meaning is developed on the basis of experience;(d) learning should be situated in realistic settings; testing should be integrated with the task not a separate activity,(e) Conceptual grows come from the negotiation of meaning, the sharing of multiple perspectives and the changing of our internal representations through collaborative learning.

From the perspective of knowing theory, constructivism is based on the idea that knowledge does not exist in an objective world, but is constructed by people. As a theory of learning, constructivism focuses on the implications of constructing knowledge for learning. In addition, constructivism includes individual (cognitive) constructivism and social constructivism. Individual constructivism conceptualises learning as the result of constructing meaning based on an individual's experience and prior knowledge whereas social constructivism takes a social and cultural perspective of knowledge creation (Vygotsky, 1978).

In constructivism, teachers are encouraged to become student-centered and play as a facilitator in indirectly guiding students through the learning process. In summarization, as behaviourism, learners might be assessed to determine a starting point for pedagogy.

As cognitivism, learners might be researched to determine their aptitude to learning. As constructivism, learners have more flexibility and control in constructing their knowledge and understanding by interaction with one another (Davis and White, 2001).

From perspectives of philosophy, (Savery and Duffy, 1995) characterized that constructivism is:

- Understanding is in our interactions with the environment.
- Cognitive conflict or puzzlement is the stimulus for learning and determines the organization and nature of what is learned.
- Knowledge evolves through social negotiation and through the evaluation of the viability of individual understandings.

In addition they also presented eight principles of instruction deriving from constructivism as follows:

- Anchoring all learning activities to a larger task or problem (e.g. to foster the capability of identifying what the problem is and setting of the learning objectives)
- Supporting the learner in developing ownership for the overall problem or task (e.g. understandings of problem before continuing toward the solution)
- Design an authentic task. (e.g. to enhance learning experience with more practice in a real context, to identify the alternatives to a problem)

- Designing the task and the learning environment to reflect the complexity of the environment they should be able to function in at the end of learning.
- Giving the learner ownership of the process used to develop a solution. (identify the problem, understand the problem, identify the alternatives)
- Designing the learning environment to support and challenge the learner's thinking.
- Providing opportunity for and support reflection on both the content learned and the learning process.

All these instructional principles mentioned above can be further explored and realised in the field of problem-based learning.

2.3 Spectrum of Learning

Lifelong learning derived from worker movement is not a new idea (Attwell, 2007). Workers would need continuous learning throughout their lifetime to update their knowledge and further enhance their occupational competences.

In addition it also refers to learning or education throughout one’s lifetime, including formal, non-formal and informal education (Cook and Smith, 2004) based on their characteristics of learning settings and context (Jeffs and Smith, 1990). In addition, Mocker and Spear proposed a similar model, but added self-directed learning to the categories (Mocker and Spear, 1982).

2.3.1 Formal learning

Formal learning can be described as learning taking place within schools with a qualified tutor followed by an organised learning plan (Smith, 1999) and thus by the description any learning taking place within a dedicated place, taught by dedicated teacher with a structured learning plan can be viewed as formal learning.

In Figure 2-1 , formal learning shows that learning objective and learning process are in the control of institution rather than learners themselves (e.g. my teacher (institution) said that I had to take Java programming course (learning process) to graduate). In figure 2-2 formal learning can be defined as learning in which both goals and process of learning are defined by the teacher.

2.3.2 Informal Learning

There are a number of definitions on what is informal learning, based on its context and settings. For example, learning takes place outside of schools (Bentley 2000). Learning objective and process are controlled by the learners can be regarded as intended informal learning (Vavoula, 2004), as shown in figure 2-1.

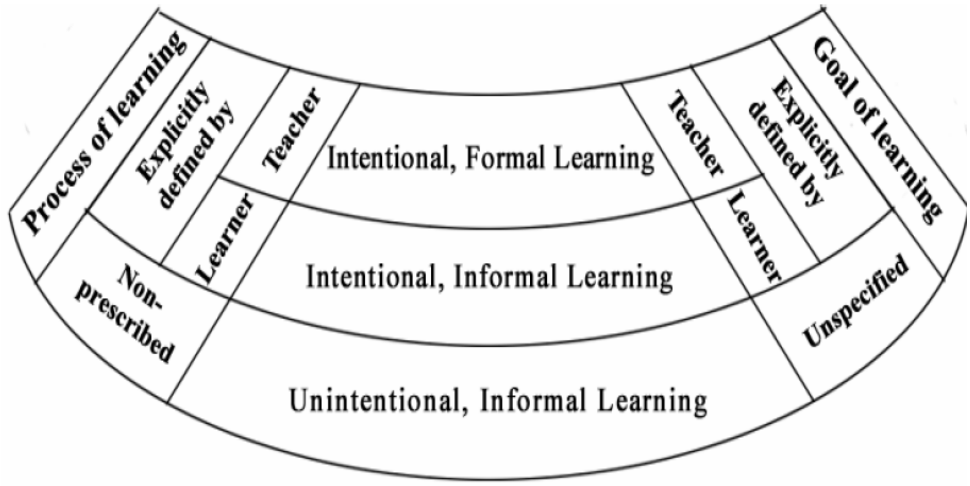

Figure 2-1 typology of informal learning (Vavoula, 2004)

In Figure 2-1, informal learning is defined as learning in which both goals and process of learning are defined by the learner, and where the learning is situated rather than pre-established.

The distinctions between formal and informal learning is that formal learning is typically described as learning that is managed in some manner by an authority (for example, at School or at University), while informal learning is less managed, or may be managed by the learner themselves (Coombs, Ahmed et al., 1974; McGivney, 1999) as shown in Table 2-1. Some researchers describe informal learning as self-education, or self-directed learning (Tough, 1979). In addition, a survey by Cross showed that 70 percent of adult learning is self-directed learning (Cross, 1981). In Table 2-1, informal learning is that learning objective is in the control of institution but the learning process is in the control of learners themselves. (e.g. The teacher (institution) asked me to do the survey about food chain but I could do it by my own way (learning process).

Process of learning / Objective	Institution	Learner
Institution	Formal learning Teacher-centred	Non-formal learning Learner- centred
Learner	Informal learning Learner-centred	Self-directed learning Learner-centred

Table 2-1 Learning model expanded from (Mocker and Spear, 1982)

2.3.3 Non-formal Learning

Non-formal learning is often described as activities outside the formal settings, characterized by voluntary as opposed to mandatory participation (Crane et al., 1994).

In Table 2-1, non-formal learning depicts that the control of learning objective is given back to the learners but the learning process is in the control of institution (e.g. I want to learn about computer technology (objective) so I think I will go to attend that workshop or conference with regard to information and communication technology (learning process).

2.4 Self-directed Learning

"The basic premise of lifelong learning is that it is not feasible to equip learners at school, college or university with all the knowledge and skills they need to prosper throughout their lifetimes. Therefore, people will need continually to enhance their knowledge and skills, in order to address immediate problems and to participate in a process of continuous vocational and professional development" (Sharples, 2000).

Self-directed learning is often described as *"a process in which individuals take the initiative, with or without the help of others in diagnosing their learning needs, formulating learning goals, identifying resources for learning, choosing and* *implementing learning strategies, and evaluating learning outcomes"* (Knowles, 1975).

A 4-steps model of self-directed learning for gifted learners was proposed by Treffinger in order to foster the ability of independent, critical thinking skills of learners (Treffinger, 1975). These four steps are followed in order: (1) A teacher controls all the learning space throughout the learning process, including learning objectives and learning process. (2) The teacher provides choices of learning objectives and process to learners. (3) Learners involve in determining and making choices. (4) The Learners can control choices of what needs to be learned.

This model is very similar to the model of "*Zone of Proximal Development*" (ZPD) proposed by Vygotsky in 1978. He states that learning occurs best when a novice learner is guided by an expert or mentor, from their current level of knowledge to the expert's level of knowledge, which means knowledge can be constructed through interaction with experienced people, mentors or expert (Vygotsky, 1978).

In figure 2-1, self-directed learning shows that both objective and process of learning are in the control of learners themselves (e.g. I have wanted to learn how to keep healthy (objective), I bet I can learn that from medical books (learning process).

2.5 Summary

In this chapter we have explored the learning-related theories and models which were employed to underpin the process of knowledge creation and the interaction of learners with real world including other people and environments, and have specified how these theories can be applied in the area of self-directed learning, personal learning with or without help from those who play as a facilitator (e.g. peers, mentors, tutors). We have also explored the ways that people approach learning (individual or social construction based on which learning theories are being applied) and how learning context can vary in terms of the formality of learning – formal, informal, non-formal and self-directed learning.

We have seen how the focus of pedagogy has shifted from traditionally passive and teacher-centred in-class teaching, to currently active and student-centred, self-directed learning. In addition, the model of instructional design may be different based on which of learning theories are being employed and the definitions of formal, informal, non- formal and self-directed learning vary in terms of context, and pedagogical settings.

Of these learning-related theories, we are interested in how independent learners can be allowed to control their learning objectives (behaviourism) and the learning processes (cognitivism), and also a focus on how to scaffold the learning process by other people (social constructivism).

In the next chapter, we will explore different approaches to building e-learning systems and investigate whether these can be described as supporting informal or self-learning, particularly for higher or tertiary education.

Chapter 3 Learning systems

3.1 Introduction

Over the last couple of decades the emphasis in educational technology research (mainly focusing on higher or tertiary education) has moved from traditionally teacher-centred learning (e.g. Virtual Learning Environments), which describes the learning space is controlled by the teacher, to more student-centred learning (e.g. Web 2.0 applications), which means that the control of learning space is partly given back to the students.

With the development of state-of-the-art technology, a number of researches and learning systems have been developed in order to adapt learning resources to individual learners such as Adaptive Hypermedia Systems (AHS), Intelligent Tutoring System (ITS), Pervasive Learning, and Personal Learning Environments (PLEs).

3.2 E-learning components

E-learning is fundamentally more about learning than technology (Joint SFEFC/SHEFE-LearningGroup, 2003; JISC, 2004) and thus the development of e-learning should be based on the needs of learners and enhancement of their educational experiences.

In the study of design of learning activity developed by Beetham and Sharpe (2007) they presented the fundamental components that e-learning system's designers should consider in the developmental process of e-learning. Such components are shown in figure 3-1.

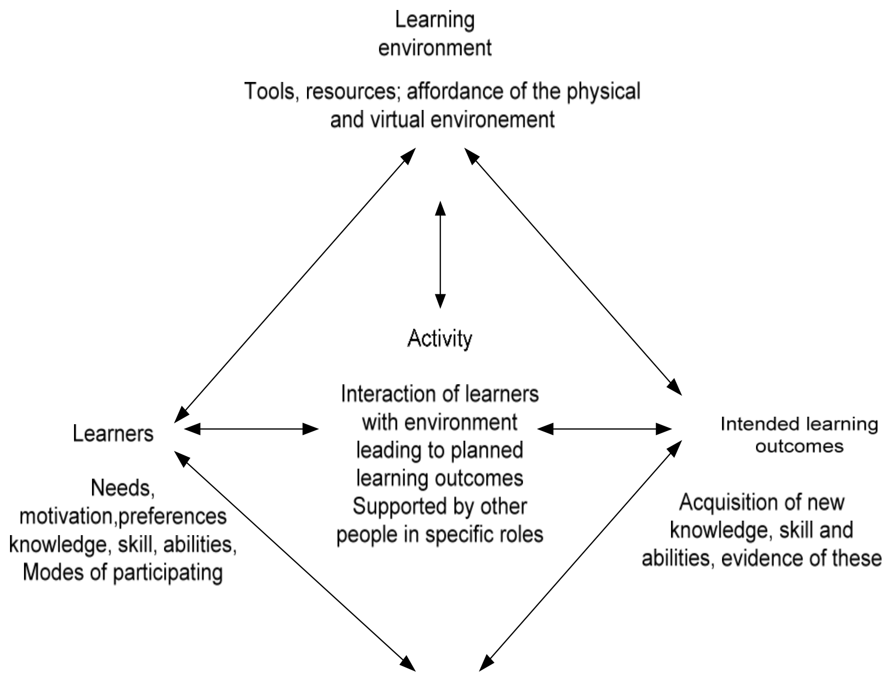

Figure 3-1 A model of learning activity design (Beetham and Sharpe, 2007)

In figure 3-1, a learning activity refers to a learning process where learners interact with other people in a way that they can help learners achieve their planned learning outcomes through supporting, guiding or challenging, or environments including the use of tools and resources. Intended learning outcomes are associated with the learning goals determined by learners themselves in a learner-centred environment. Learning environments provide the learners with essential tools, available resources, and services, including physical and virtual learning environment.

At present there have been many e-learning systems or models which employ adaption techniques to present adaptive content of course materials to the learners with different learning styles, preferences, needs, and levels of knowledge. These systems are intelligent tutoring system (ITS) and adaptive hypermedia system (AHS). In addition with the pervasiveness of mobile technologies, learning can take place anywhere at anytime, leading to a mobile, pervasive, ubiquitous, personal learning environment.

3.3 Educational Hypermedia System

Educational hypermedia systems are hypermedia-based systems in which pedagogic materials are statically represented in hypermedia format upon which a learner can freely explore the materials, and learning process is fully controlled by learner themselves (user-driven learning process) (Brusilovsky, 1996).

However learners in educational hypermedia systems, with different level of knowledge of the subject matter, are often statically being presented the same material, which results in the negative effects “one size fits all” (Brusilovsky and Maybury, 2002).

Moreover, the lack of navigational support makes learners easier to get lost in the hyperspaces without the acquisition of knowledge (Hammond, 1989). Thus developing systems with an ability to adapt learning resources to their learning behaviours is crucial to remedy the one-size-fits-all problem.

Therefore how to model the learners’ information in order to support them with appropriate learning content and activities while progressing through the hyperspace is the main concern in the development of personalised learning system.

3.4 Scrutable User Modelling

Modelling the solutions to the problem or learning events into a set of independent models is conducive to the development of an application or system (e.g. object-oriented modelling), and make them connected to reality (Booch, Rumbaugh et al., 2005). In the process of development of a personalised system, it is essential to design a core model for recording a user’s interaction with a personalised system.

User modelling approach is widely applied to the field of personalised learning systems which employ a user model to record learners’ behaviours in order to structure and sequence the learning activities to be presented in a way that learning resources can be to and catered for the needs of independent learners.

Scrutable user modelling can be defined as a user model with scrutablity which means that this user model can be capable of being understood by the users through allowing them to control or modify their model to fit their learning behaviours (Kay, 2008; Kyriacou, 2008). Such user modelling approaches are used in the research community of ITS (Greer and McCalla, 1994), AHS (Brusilovsky, Eklund et al., 1998;

De Bra and Calvi, 1998; Dolog, Henze et al., 2004) and Lifelong learning-related system or model (Koper, Giesbers et al., 2005; Kay, 2008; Kyriacou, 2008).

3.5 Intelligent Tutoring System

Intelligent Tutoring Systems (ITSs) are systems employed in facilitating the learner in the acquisition of knowledge by dynamically adapting the learning materials to the individual (Wenger, 2004). Such systems automatically provide customized instructions or feedback to the learners while performing a learning task.

In ITS learners are guided directly through dynamic interaction with the systems throughout the learning process. An Intelligent tutoring systems includes four main components: problem solving environment (Interface), domain knowledge (expert module), student model (learner module), and pedagogical module (tutor module). Each model has its responsibility for guiding and adapting the learning resources to the learner throughout the learning process. Examples of ITSs are CTAT (Koedinger, Aleven et al., 2003), Cognitive tutor (Anderson, Corbett et al., 1995).

3.6 Adaptive Hypermedia System

In order to deal with a variety of needs for different individual learners, hypermedia learning systems have shifted from "one size fits all" to adapting learning resources to each distinct individual learner, towards an adaptive learning environment.

"Adaptive hypermedia is a new area of research at the crossroads of hypermedia, adaptive systems and intelligent tutoring systems" (Beaumont and Brusilovsky, 1995). An adaptive hypermedia system, a software system which extends from educational hypermedia and combines elements of intelligent tutoring systems, user modelling and artificial intelligence, employs adaptive technology which provides learners with adaptive presentation and navigation through the process of acquisition of knowledge.

This adaptive technology employs a user model (as shown in Figure 3-2) in which goals, preferences, and knowledge level of each individual learner are collected in order to adjust the presented information to the learner, e.g. within an adaptive hypermedia system a learner is given an adaptive presentation to his knowledge of the subject (De Bra and Calvi, 1998) and a suggested set of most associated links (navigation) for further proceeding (Brusilovsky, Eklund et al., 1998).

For learner-related personalisation systems, the way of allowing the learner to dynamically modify and control their learning behaviours is to use a scrutable user model for lifelong learning (Kay, 2008; Kyriacou, 2008), this allows user to understand why the system is treating them a particular way, and also allows them to correct any mistakes.

In addition a domain model related to how concepts are structured by the relationships among them is employed and an adaptive engine based on the learners' level of knowledge of the subject is employed to make connection between a domain model and a user model. With the use of the technique of adaptation of presentation and navigation, learners can achieve their desired learning outcomes, and thus it is learner-directed.

Examples of adaptive hypermedia systems are ELM-ART (Weber and Brusilovsky, 2001), InterBook (Brusilovsky, Eklund et al., 1998), PersonalReader (Dolog, Henze et al., 2004), and AHA! (De Bra, Aerts et al., 2002).The goal of adaptive hypermedia is to improve the usability of hypermedia through the automatic adaptation of hypermedia applications to individual users (De Bra, 2000).

As compared to educational hypermedia environments, the design of adaptive hypermedia is more learner-centred, oriented by employing a user model in order to direct learner to achieve intended learning outcomes.

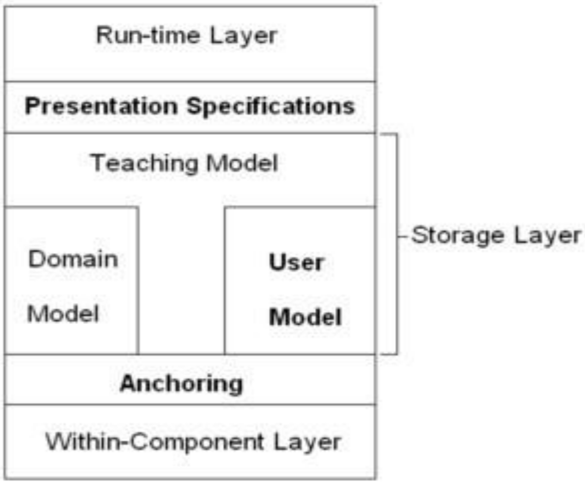

Figure 3-2 The AHAM model (De Bra, Houben et al., 1999)

3.7 Personal Learning Environments

In the last few years a debate has started about which of these approaches (Virtual Learning Environment, or Personal Learning Environment) suites a new generation of tech savvy teenagers (sometimes called Generation Y, or Millennials), this new generation has been stereotyped as "*Digital Natives*" (Prensky, 2001) – people who are at home online and come to an educational institution with their own set of digital tools already in place (for example, email, social groups and web presence).

As revealed by a JISC Report in 2008, it suggests that this difference is cultural (familiar with technologies and using it with confidence) rather than generational (using technology in childhood) (JISC, 2008), however, with an increase in the use of Web 2.0 technology, and the popularity, ubiquity of mobile devices, the impact of technology use on learners has changed their expectations of what their learning environments should provide. An issue rises from the discussion with regard to whether a Virtual Learning Environment can offer a personalised learning environment with suitable managing and communicating tools to the people who are engaged in personal learning (Adams and Morgan, 2007).

Personal Learning Environments (PLEs) are systems that allow individual learners to manage and control their own learning using their own mix of (often third party) tools (Wilson et al., 2006). Because of the level of independence that they grant to a learner they are often associated with informal learning.

This includes providing support for learners to:

- set their own learning goals
- manage their learning, both content and process
- communicate with others in the process of learning

Therefore the emergence of Personal Learning Environments, software systems which learner can choose and tailor to fit their own learning preferences, has become alternative to VLE approach where students can be given back the control of their learning space. In a PLE the student can manage their own learning experience or preferences knowledge (Conole et al., 2006; Harmelen, 2006; Wilson et al., 2006; Adams and Morgan, 2007; Attwell, 2007; Chatti et al., 2007; Attwell et al., 2008; Margaryan et al., 2008; Redecker et al., 2010), for example by managing their time, helping to organise learning goals and activities, collating reference material, monitoring the learning progress towards intended learning outcomes by revising their plans as needed. Thus, in PLEs learning experience, such as learning process and learning activities, seems to be in the control of the learners rather than the teachers.

PLEs are described as an intervention strategy into the relationship between technology, learners' engagement and institutional function within an increasingly complex organisational setting (Johnson and Liber, 2008). PLEs are not an application; instead they represent a new approach to using educational technologies for learning and could be to extend access to educational technologies to people who might expect to organise their own learning, such as informal learning which includes learning from the home, workplace, driven by problem solving and motivated by personal interest as well as learning through engagement in formal educational programmes (Attwell, 2007).

3.8 Mobile Learning Systems

The term M-Learning, or "mobile learning", has different meanings for different communities. Although related to e-learning and distance education, it is distinct in its focus on learning across contexts and learning with mobile devices. One definition of mobile learning is: Any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies. In other words mobile learning decreases limitation of learning location with the mobility of general portable devices.

Mobile learning is learning with mobile devices (Attewell and Savill-Smith, 2004). It is becoming increasingly common for people to own their mobile devices. In terms of the personalised nature of mobile technologies, mobile learning provides an excellent platform in support of the development of personalised, learner-centric educational experiences (Low and O'Connell, 2006). As applied by educational research, mobile technologies can be regarded as a service that electronically presents pedagogical resources to learners anywhere at any time (Lehner and Nosekabel, 2002).They are often being employed to support informal learning as such they are a good fit to the idea of personal learning environment (Arnedillo-Sánchez, Sharples et al., 2007; Chen, Millard et al., 2008).

Numerous studies and systems or framework focused on the affordance of mobile technologies have been conducted and developed in support of pedagogy. Below these systems and experiences are categorised in terms of their general type (e.g. fieldtrip support, or assessment).

The categorizations of these learning systems are as follows:

- Collaborative learning environment

  GiftFinder (Montebello and Camilleri, 2011), Tweetalyser (Montebello and Camilleri, 2011), *GPS-Aided Geocaching* (Chen and Shih 2011). All of these aimed to provide students with an interactive learning environment by means of use of social software and mobile functionality such as GPS.
- Remote control environment

  Remote Laboratory system (Mittal and Gupta, 2007) *and Mobile Engineering Laboratory Application* (Mittal, Pande et al., 2007). These systems use a mobile device to control and supervise a remote laboratory.
- Language training

  Facilitating EFL writing (Hwang, Chen et al., 2011) aim to help the people improve their language ability. The former focused on English grammar and the latter concentrated on listening, speaking, reading and writing of the Irish language.
- Assessment

  Accessing Mathematics through Mobile Learning (Cristol and Gimbert, 2011) enables formative assessment for Maths on mobile device.
- Lifelong learning

  MobiMOOC (de Waard, Koutropoulos et al., 2011) is an online course focusing on mobile and lifelong learning, *and Museum visiting* (Bressler and Kahr-Hojland, 2007) was a spontaneous visiting application (without the requirement of a structured fieldtrip).
- Feedback

  Voting system was devised (So, 2007) to allow students to use their mobile devices to vote on a topic or subject.

3.9 Summary

In this chapter, we have reviewed the fundamental components that e-learning systems should contain, including learners, intended learning outcomes, learning environment, and people involved (e.g. mentors, experienced people), and personalisation-related learning systems such as ITS, AHS, Pervasive and Mobile learning systems have been discussed. We have also seen how scrutable user models can be used to give more control to learners.

Mobile systems seem a good fit to personal learning. However, although most adaptive hypermedia systems offer a user model for adaptive presentation of learning resources to the needs of individual learners, learning environment regarding the availability of resources (e.g. resources available only for legal users who have registered the system) the flexible use of tools (e.g. communication tools, collaborative authoring tools) and the way they approach learning (e.g. a self-organised learning group) are still in the control of administrative or educational institutions.

In order to explore this further we need to have a way of characterising the formality or informality of a given system. In the next chapter a framework relevant to formality of learning is proposed, our intention is to then use this framework for exploring whether current e-learning or mobile learning systems are in the spirit of a PLE or a VLE.

Chapter 4 A 4D Model for learning systems

4.1 Introduction

The previous chapters described how different learning theories and methodologies have resulted in a variety of different e-learning technologies. The observation was made that there appears to be a good match between mobile systems and personal learning environments. In this chapter a 4D model of formality in e-learning systems or mobile learning systems is developed in order to explore whether existing mobile learning research is more in the spirit of PLEs or VLEs, and a survey of the mobile learning systems presented at m-learn 2007 is conducted using this 4D model in order to further understand which aspects of learning are formalised in these systems, and therefore how personally directed they really are.

4.2 4D Model

4.2.1 What a 4D model for

A 4D framework is presented for describing formality in e-learning systems and mobile learning systems, which can account for the most common perspectives: formality focused on Learning Objective, Learning Environment, Learning Activity and/or Learning Tool. The framework can be used to compare different e-learning systems and different mobile learning systems, and explain the difficulty with the existing learning models of formal and informal learning, in which each model comes from a different perspective, where they value certain types of informality more than others, for example learning direction over learning location. Thus what is informal to one model could be formal to another.

4.2.2 What is the 4D model?

This 4D model is based on typical “who, what, when, where, and how” questions, similar to the idea of learning ecosystem that contains biotic and a biotic units mentioned before. As such the learning experience can be considered as a whole rather than looking solely at the System. For example, this means a given system can be less or more informal depending on how and when it is being used. Table 4-1 shows how these six questions form four dimensions.

The model has simplified the six questions down to four dimensions by considering Environment (Where and When) and Activity (What and Who) as two rather than four criteria. This have been done for two reasons: firstly, this is the level at which they are commonly described in the literature where environment and activity are well understood terms; secondly it simplifies the classification process and enables effective presentation of any results, making them easier to analyse. These four dimensions are as follows:

- Learning Objective (the goal of the activity - Why is the student doing this activity?)
- Learning Environment (the place and time of the activity - *Where* is the learning activity happening and *When* is it happening?)
- Learning Activity (the activity itself - *What* is it that the student is going to actually do, and *Who* are they doing it with?
- Learning Tools (the tools used to do the activity - *How* are they going to undertake the activity?)

Question	Dimension	Higher level
Where	Learning Environment	Context
When		
What	Learning Activity	
Who		
How	Learning Tools	
Why	Learning Objective	

Table 4-1 Relationship of Key Questions to Dimensions to Higher-Level Terms

4.3 An Example Scenario Placed in the 4D Model

When placing a given m-learning experience in the framework, it can be said that for each dimension a system is either *student-led*, *teacher-led*, or *negotiated* (meaning that both student and teacher had some say). Three classifications are given on each of the four dimensions, thus being allowed to potentially distinguish between 81 different types of formality and informality. This can be captured in shorthand using S, N or T for each dimension in turn (Student, Negotiated, Teacher). So for example it might be said that an experience in which all four dimensions are controlled by the teacher is TTTT, but one in which the Learning Environment is controlled by the student is TSTT.

The 4D Model allows us to step back slightly from disagreements about what constitutes formal learning; it shows that one's opinion of formal learning will change according to which of the four dimensions one holds most valuable. This is how different commentators can draw different conclusions about the formality of the same learning experience.

An example is given as follows: Example:

A School Nature Fieldtrip

> *"Clare is using a PDA to record observations that she is making on a school nature fieldtrip. Clare's teacher has asked her to write descriptions of the wildlife that she sees in order to understand more about the food chain. The teacher has asked Clare to use a special journal application on her PDA to write her observations, which then synchronises to a central server so that Clare can access them at a later time."*

Using our 4D model we would classify this m-learning experience as TNTT: The demonstration is as follows:

- Learning Objective – Set by Teacher (to understand more about the food chain)
- Learning Environment – Negotiated (fieldtrip is at a set time and place, but Clare is free to move about within the area as she likes)
- Learning Activity – Set by Teacher (to record observations in a journal)
- Learning Tools – Set by Teacher (Clare must use the special journal application on the PDA)

4.4 The surveyed systems

This section explores the question of whether existing m-learning research is more in the spirit of PLEs or Virtual Learning Environments (VLEs). To do this the surveyed learning systems presented at Mlearn 2007 were surveyed in order to show the formality of these learning in order to see how they might be regarded as informal or formal learning.

These systems and experiences are categorised in terms of their general type (e.g. fieldtrip support, or assessment). Several of the systems come from the same paper.
The categorizations of these learning systems are as follows:

- Collaborative learning environment

  MOULE system (Arrigo, Giuseppe et al., 2007), *Mobile Jigsaw project* (Thompson and Stewart, 2007), *Theory and practice of mobile learning in school project* (Hartnell-Young, 2007), *MyArtSpaces system* (Sharples, Lonsdale et al., 2007), *Mobile Blogging* (Cochrane, 2007), *StudentPartner system* (Hwang, Hsu et al., 2007), *Mobile Group Blog to support Cultural Learning* (Shao, Crook et al., 2007). All of these aimed to provide students with an interactive learning environment by means of use of social software and mobile functionality such as GPS.

- Remote control environment

  Remote Laboratory system (Mittal and Gupta, 2007) and *Mobile*

Engineering Laboratory Application (Mittal, Pande et al., 2007). These systems use a mobile device to control and supervise a remote laboratory.

- Language training

  ESL system (Ally, Schafer et al., 2007) and *Mobile phones for language learning project* (Cooney and Keogh, 2007) both aim to help the people improve their language ability. The former focused on English grammar and the latter concentrated on listening, speaking, reading and writing of the Irish language.

- Assessment

  Examination system (So, 2007) aimed to assess learners using mobile devices, *MOBI system* (Matthee and Liebenberg 2007) enables formative assessment for Maths on mobile device, *and 15/16 Game system* (So, 2007) was to test students by means of interaction with other people.

- Lifelong learning

  Adapt-VLE system (Elson, Reynold et al., 2007) is used to train learners about changes of medical information, and *Museum visiting* (Bressler and Kahr-Hojland, 2007) was a spontaneous visiting application (without the requirement of a structured fieldtrip).

- Feedback

  A voting system was devised (So, 2007) to allow students to use their mobile devices to vote on a topic or subject.

4.5 Categorising the systems according to the 4D model

These 17 systems are categorized with the 4D model. The results are shown in Table 4-2 below. Systems with the same 4D profile are grouped together in adjacent rows for clarity. There are six groups covering the whole table, and they have been arranged so that the most formal group is at the top and the least formal is at the bottom. Student led values are shown in light grey.

System / project	Context				
	LO	Env'	Act	Tool	Grp
Voting system (So, 2007)	T	T	T	T	1
15/16 Game system (So, 2007)	T	T	T	T	
MOULE system (Arrigo, Giuseppe et al., 2007)	T	N	T	T	2
Mobile phone for language learning (Cooney and Keogh, 2007)	T	N	T	T	
Theory and practice of mobile learning in school (Hartnell-Young, 2007)	T	N	T	T	
Examination system (So, 2007)	T	N	T	T	
Mobile Group Blog to support Cultural Learning (Shao, Crook et al., 2007)	T	S	T	T	3
Mobile Jigsaw project (Thompson and Stewart, 2007)	T	S	T	T	
Remote Laboratory system (Mittal and Gupta, 2007)	T	S	T	T	
ADAPT-VLE system (Elson, Reynold et al., 2007)	T	S	T	T	
Mobile Engineering Laboratory Application (Mittal, Pande et al., 2007)	T	S	T	T	
MOBI system (Matthee and Liebenberg, 2007)	T	S	S	T	4
Student partner system (Hwang, Hsu et al., 2007)	T	S	S	T	
MyArtSpace system (Sharples, Lonsdale et al., 2007)	T	S	S	T	
ESL project (Ally, Schafer et al., 2007)	S	S	T	T	5
Museum visiting (Bressler and Kahr-Hojland, 2007)	S	S	S	S	6
Mobile Blogging (Cochrane, 2007)	S	S	S	S	

Table 4-2 Systems/projects within the mlearn2007 conference papers

4.5.1 *Example of a System in Each group*

To indicate the thinking behind our classification one system from each group has been chosen to describe in more detail. In each description the places have been indicated that the description matches the 4D Model using the simple notion of LO/Env/Act/Tool followed by T/N/S. So for example, it might say “The student uses their PDA on a fieldtrip (**Env:N**)" to indicate that because it is a fieldtrip the *Environment* dimension is *Negotiated*.

Group 1 (TTTT)

15/16 Game System - Students are asked to use a WAP browser on their mobile phones (**Tool:T**) in the classroom (**Env:T**), to participate in a class game called 15/16. The teacher asks a question (**LO:T**) and the students can choose from a multiple choice answer (**Act:T**), the teacher (or another student) then tries to convince the students to change their minds, by giving a plausible explanation for one of the answers (whether it is right or wrong). The Mobile phones send the students answers and any changes to a server, and the teacher can show this to the class to show the number of students who got it right, and those that changed their minds.

Group 2 (TNTT)

MOULE – is a system that allows students to collaborate through a Moodle-type portal in order to communicate and share resources. For example, a lecturer wishes to teach her students about the architecture in a particular square (**LO:T**), she sets up an activity in Moodle that asks students to make notes about particular points of interest (poi) (**Act:T**). A student visits the square and is free to explore the space, and find the poi that have been described (**Env:N**). Once the poi has been found, the student can take a photo using the built in MOULE toolkit (**Tool:T**). One interested twist with this system is that students back in class (**Env:T**) can collaborate with the students in the field (**Env:N**). Thus MOULE can be used (at least partially) in an informal way (TNTT), but for the student in the classroom it is a more formal experience (TTTT).

Group 3 (TSTT)

Mobile Jigsaw Project – used mobile devices as an enabler for group work. Teachers chose an issue in the children's local area (**LO:T**), and created small groups of children who were given a number of devices with preloaded software, such as digital cameras, and a tablet PC (**Tool:T**). The children then plan their own fieldtrip (**Env:S**), and visit the environment where they work as a team to gather evidence in order to ask science-based questions back at the classroom (**Act:T**).

Group 4 (TSST)

MOBI System – Students use a bespoke MOBI client (**Tool:T**) on their PDAs to access a wide variety of Activities concerned with Maths (**LO:T**). Students can choose which activities they feel might be useful to them (**Act:S**), and undertake those activities whenever and wherever they like (**Env:S**).

Group 5 (SSTT)

ESL Project – uploaded a wide range of grammar exercises to a student's mobile device. At a time or place of their choosing (Env:S), the student could choose to test or expand any part of their knowledge of grammar (LO:S). They would then take an appropriate pre-loaded exercise (Act:T) using a browser on their mobile device (Tools:T).

Group 6 (SSSS)

Mobile Blogging – gave an overview of how blogs might be accessed, written and used on a mobile device. In the given scenario a student accesses the blog throughout their day (**Env:S**) on whatever device they have available using a variety of browsers (**Tool:S**), the blog offers them general functionality, allowing them to explore items of interest with their friends (**LO:S**), and supports a wide range of activities such as journaling, mircoblogging, discussion, comments, etc. (**Act: S**).

4.6 Analysis and discussion

When this study was undertaken we expected to see that Mobile Devices support informal learning across the 4D Model, however it is clear from the analysis that while the majority of mobile applications have an informal environment (ether where or when the student can use the tool), relatively few are informal in other ways.

Figure 3-1 shows the ratio of Teacher-Led to Student-Led in each of the four dimensions (negotiated is not shown in the figure). It clearly shows that Informal Environments are far more frequently supported than Informal Objectives, Activities or Tools.

Partly this may be because the sample was from research papers, where authors are often describing trials of particular tools (so for example, it is expected to see fewer choices for participants regarding which tool they could use). However, it could also be argued that while the data reflects the methods of experiments, it is still valid in that it tells us that there are few mobile experiments being conducted where users *do* have a choice of tools. In effect, while mobile learning claims to be conducive to informal learning – only a very restricted type of informality is currently being explored by the research community.

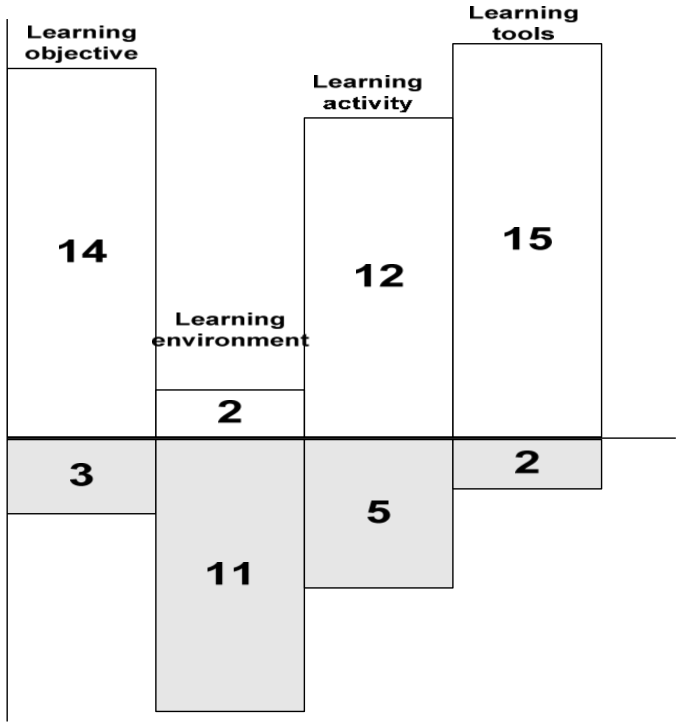

Figure 4-1 The ratio of T and S for each dimension

Figure 4-2 compiles the data from Table 4-2 into a matrix that shows the four dimensions (a 3x3 grid of 3x3 grids). Each cell of the matrix has been shaded to reflect the overall level of informality of that cell, the darker the cell the more informal it is (so TTTT is white, SSSS is almost black, and TTSS and SSTT are the same shade of grey. The number of systems in a given cell is shown in a white circle over that cell. In effect this diagram shows a map of informality in the surveyed systems. From this diagram it is clear that whole areas of possibility are not being explored, in particular Negotiated Learning Objectives (such as placement study), and Informal Learning Objectives in Formal Settings (such as project work in school)

As a whole, this study shows that in mobile learning research systems, teachers are more likely to take control of learning objectives, activities and tools but less likely to control the student's environment. This seems to be because mobile learning research focuses on the geographic mobility of devices (rather than their ubiquity, or any sense of student ownership and thus potential control).

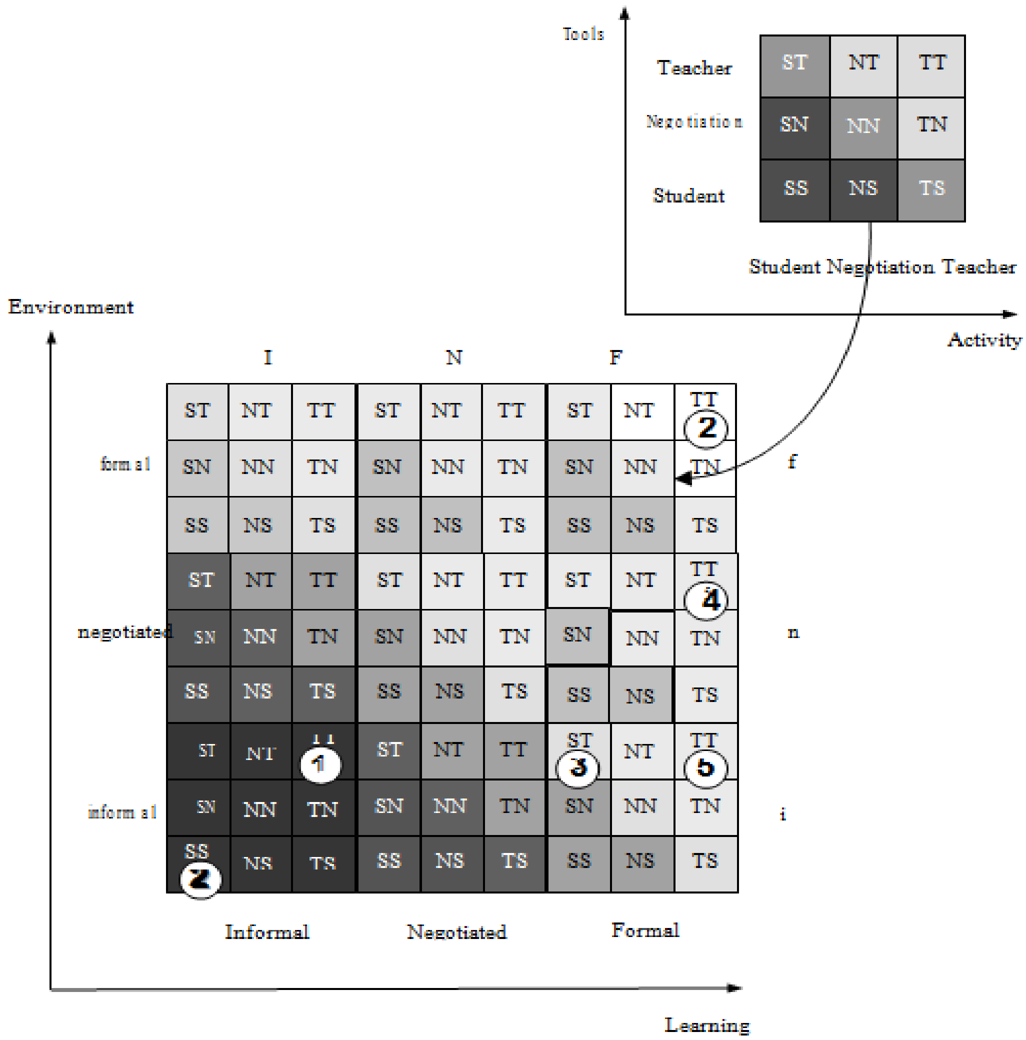

Figure 4-2 The landscape of Informality in this study

4.7 Summary

In this section, the issue on whether m-learning systems and applications tend to be in the style of Virtual Learning Environments (VLEs) or Personal Learning Environments (PLEs) has been explored using novel 4D model of formality. It is concluded that the major factor is the formality of the learning, as PLEs support a range of informal activities, but VLEs tend to support more traditional formal activities.

Although m-learning applications seem well placed to become part of a student's

PLE, little research is being undertaken to understand how they could be used in this way. In essence m-learning researchers are reinventing the VLE on the mobile device, rather than looking at how to use them to support more subtle aspects of informal learning found in the increasingly important PLE area.

In order to see how existing systems personalise learning experience by the techniques or model that they employed, in the next chapter we will explores the extent to which these existing models or systems for learning design can be used to support or underpin the idea of personal learning.

Chapter 5 Data Modelling Process

5.1 Introduction

In the last chapter we developed the idea of a 4D model of formality, and then used this model to examine how informal mobile learning systems tend to be. We discovered that while many learning systems claim to support informal learning, in practice only part of the learning experience is informal. There is still a great scope to explore mobile systems that have informal learning objectives, and this requires systems that understand the learning process and can respond appropriately to students who are choosing their own learning objectives and outcomes.

Therefore a learning model with scrutability can solve this problem, which is capable of being understood well by learners by scaffolding the process of providing them with rationale that they can understand why and how (observation) to do during the interaction with a system, e.g. By showing independent learners this model, they can understand the intention behind the design of a learning task and then can choose a better learning path to fit their own learning preferences. In this chapter the scrutability of a number of existing models will be assessed for scrutable use.

There have been a number of tools and models developed for driving the development of educational approaches and enhancing the reusability of learning resources across institutions.

This chapter gives an introduction to tools used for learning, e-learning standards and specifications: (SCORM, 2004), (IMS Learning Design, 2003), and (IMS Simple Sequencing, 2003).

5.2 Concept Maps

Concept mapping has been proposed as a tool for personal understanding of science, as described by Novak in the 1970's based on the cognitive theory of Ausubel (Ausubel, Novak et al., 1978). A concept map, as shown in Figure 5-1, is a graphical representation of concepts with labeled links showing the interrelationships amongst concepts (Novak and Gowin, 1984).

By the definitions of concept mapping, the more general concepts are presented at the top or centre in contrast to those which are more specific and detailed at the bottom or around the edges. The links between concepts are based on propositions and linking phrases that should be as short as possible and the root node of the concept map represents the main topic of the concept map.

Concept maps can be applied in many areas for different purposes (Novak, 1990; Jonassen, Reeves et al., 1997; Seedorf, Korthaus et al., 2005; Willis and Miertschin, 2006; Miertschin and Willis, 2007), such as note taking, knowledge creation and elicitation, instructional design, assessing the understanding of learning objectives, meta-cognition, and communication of complex ideas.

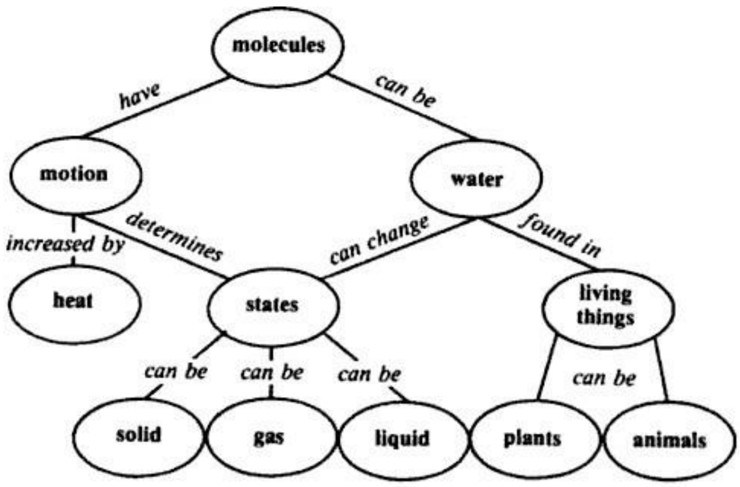

Figure 5-1 A concept map concerning molecules (Novak and Gowin, 1984)

5.3 SKOS

SKOS (Simple Knowledge Organization System), developed by W3C, is a semantic web language used to describe simple knowledge structures for the web (Miles, Matthews et al., 2005). It is designed for representation of thesaurus, classification schemes, taxonomies, subject-heading systems, or structured controlled vocabulary based on RDF (Resource Description Framework) and RDFS ((Resource Description Framework Schema).

As compared to OWL (Web Ontology language), SKOS provide a mechanism to make a legacy of concept schemes available to Semantic Web applications, simpler than the more complex ontology language.

SKOS can be used as a tool for creating a concept map- a graphical representation of inter-relationships of concepts (as described in Section 5-2), which can give an overview of what needs to be learned for the learners and can make it easier for learners to organise their study plans.

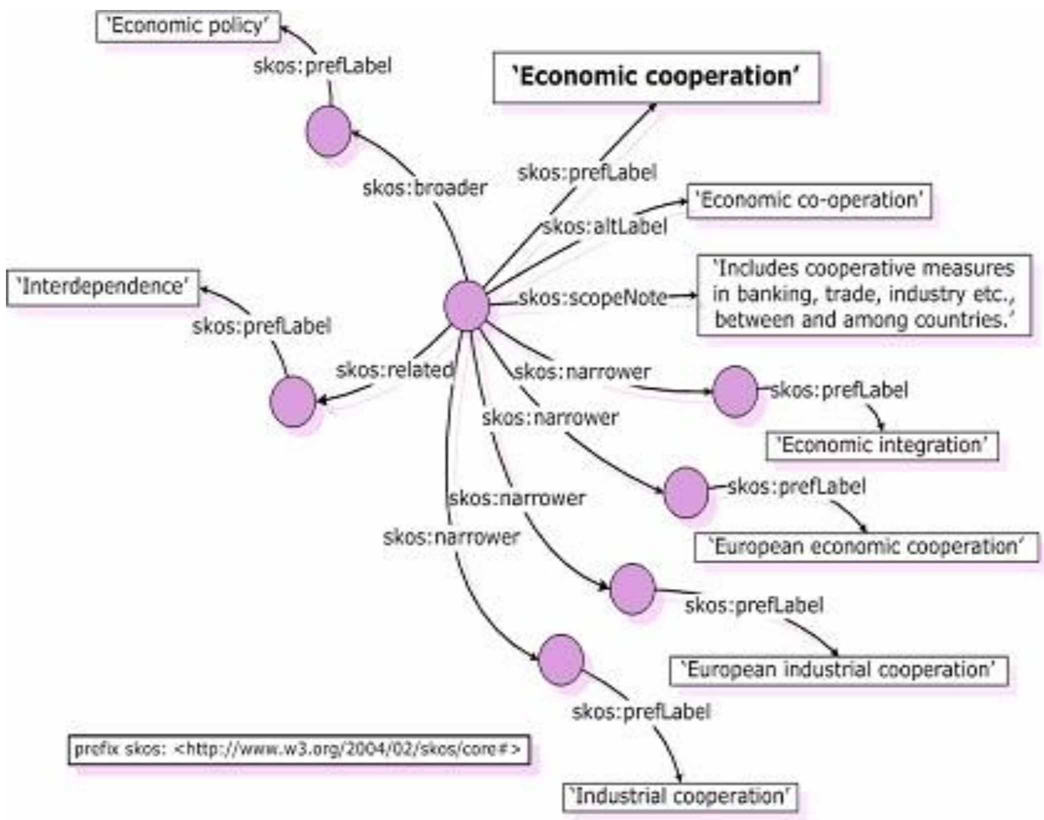

Figure 5-2 an RDF graph using SKOS core vocabulary (SKOS 2005)

5.4 SCORM

SCORM (Sharable Content Object Reference Model) is a collection of standards and specifications by Advanced Distributed Learning (ADL) that defines how content may be packed to interoperate among different web-based learning systems.

In SCORM 1.3, the learning unit, called a SCO, includes its structure and the rules defined in the manifest of the SCO (as shown in Figure 5-3), which manage the learning activity. Each manifest describes both the structure into which the learning material is assembled and the way in which it is presented. The decision by which the next item to show is taken by the SCORM-compliant Learning Management System (LMS), based on the rules contained in the manifest and on features that depend on the user behaviour.

SCORM 2004 employs a sequencing approach composed of a set of rules, which specifies the order in which a learner may experience content objects (SCORM, 2004; IMS Content Packaging, 2005). In simple terms, they constrain a learner to a fixed set of paths through the training material, permit the learner to bookmark their progress when taking breaks, and assure the acceptability of test scores achieved by the learner.

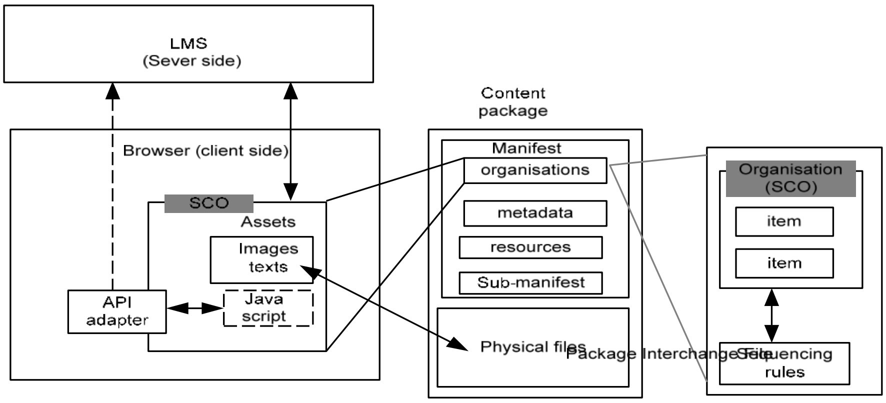

Figure 5-3 SCORM run-time environment (partial) and Package Interchange File

5.5 IMS Simple Sequencing

IMS Simple Sequencing (SS) is a specification, adopted by ADL SCORM 1.3, for presenting a learning sequence to a leaner through a learning task towards a specific learning objective (IMS Simple Sequencing, 2003). It is composed of a limited number of sequencing behaviours based on instructional design strategies chosen by the tutors.

These behaviours include sequencing control mode, sequencing rule condition and sequencing rule action, and learning activities are performed and managed in an activity tree as shown in Figure 5-5, in which each node refers to as a learning activity, such as learning content or test questions, and activities related to other activities are structured into a hierarchical structure. The concept of clusters used in simple sequencing refers to single node (parent node) and its immediate node (children node) and are associated with the sequencing rules. For example, in Figure 5-4 'variables' (parent node) and its children node 'instance variables and local variables' form a cluster.

Simple Sequencing rules are associated with clusters of activity nodes. In Simple Sequencing, the term cluster refers to a single node and its immediate children. The scope of a particular rule never extends beyond the cluster. For example, many rules govern how to handle the sub-activities in a cluster, or rollup the result of the sub-activities in a cluster. Those rules are associated with the parent node in the cluster. Other rules are associated with a specific activity and do not affect its children

In addition, the sequencing behaviours, separated from their learning content, are encoded using XML in a manifest file result in increasing their reusability and interoperability among distinct learning management systems.

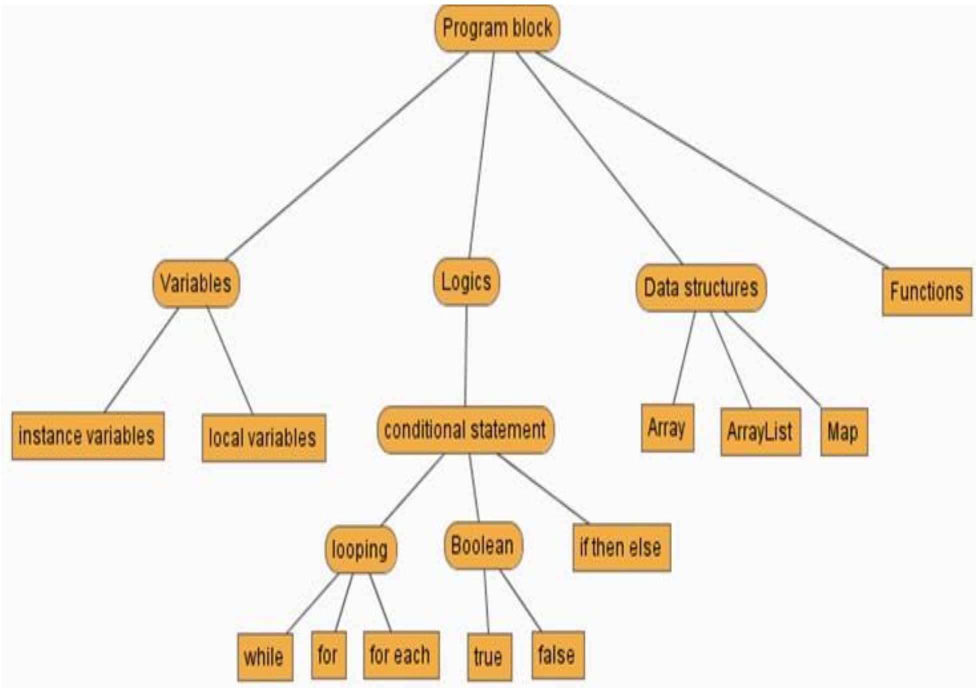

Figure 5-4 An Activity tree for Basic Programming

5.6 Case study

In this section, two examples were taken in order to understand whether the SKOS data model and IMS Simple Sequencing can meet the requirement of the design of a concept map where novice learners can orientate themselves in advance before starting learning about a topic.

In this case study, based on a programming course, it is assumed that all the learners are novice beginners for learning programming languages. A concept map which is associated with the fundamental concepts and related learning skills was created. This concept map was created with the SKOS data model based on Java course and book Blue J. In addition the IMS Simple Sequencing specification was adopted to construct two learning orders based on the order of topics found in the book, and the alternative order in which they were presented in the COMP1004 Programming Principles course at Southampton that uses the book as a recommended text.

5.6.1 Expert review

An expert review is an approach to evaluating a user interface, taken by a group of experts rather than users (Molich and Jeffries, 2003). The aim of this expert review is to obtain a better understanding of whether SKOS and SS adequately capture the topics and sequence of learning in our programming case study.

To do this, an expert review was conducted by interviewing teaching and supporting staff of School at the Electronics and Computer Science of University at Southampton about the SKOS and IMS models created.

5.6.2 Methodology

Before conducting an expert reviews, we organized a plan with regard to looking for the stakeholders, articulating the motives for the interview activity, making an appointment with each expert reviewer if accepted, and finally conducting the expert review in a tutoring room. The purpose of this expert review is to examine the quality, usefulness and appropriateness of a concept map created with SKOS and two simple sequencings created with IMS SS, both based on the lecture taught in Java course and Book Blue J, for learning and teaching. In order to respect the privacy of interviewees, the given feedback from each interviewee was recorded anonymously. More information can be found in Appendix A.

The chosen target expert reviewers are people who are familiar with Java programming such as teaching staff and support staff for programming courses. Five expert reviewers were chosen. During the interview, each reviewer was given the concept map and the two simple sequencing models associated with learning java programming (the concept map represented a combined map of all the topic in both the book and the course, with one simple sequence from the book, and another from the course).

This expert review began by showing the interviewee the models, then a brief presentation was given on the SKOS model before going into the next step of questioning. Questions were separated into two parts. Part one includes six questions about the SKOS model (Concept Map). Part two consists of eight questions about simple sequencing combined with concept map. More details can be found in Appendix A.

After finishing questioning of part one, a briefly presentation on Simple Sequencing was given and then a second series of questions were asked. The entire process of expert review is shown as Figure 5-5. The one concept map and two simple sequencing models are shown in Figure 5-6, Figure 5-7 and Figure 5-8 respectively.

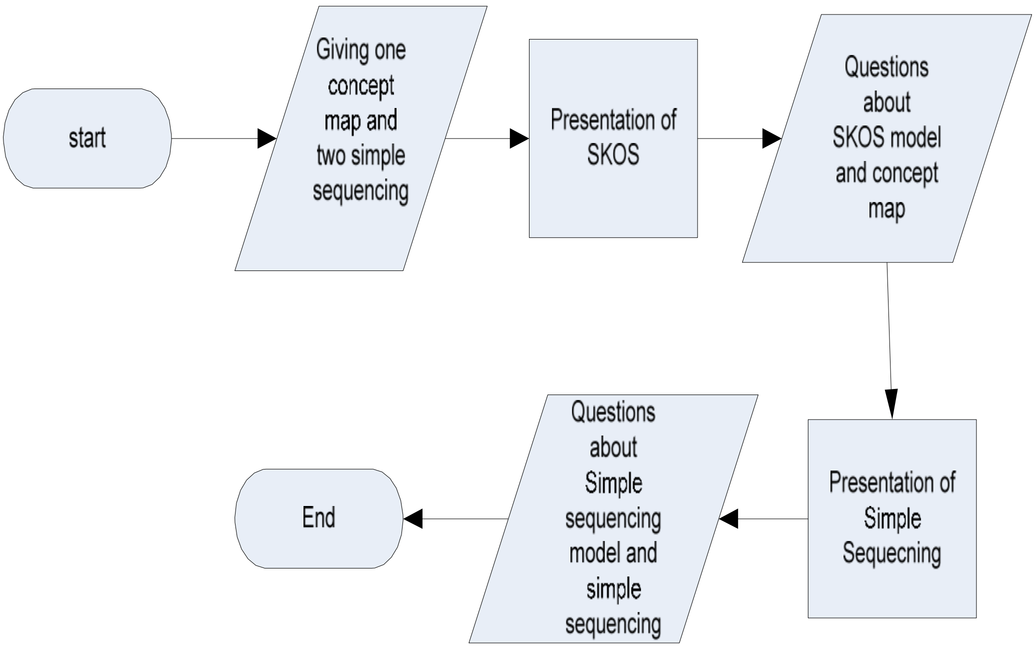

Figure 5-5 the workflow of expert review

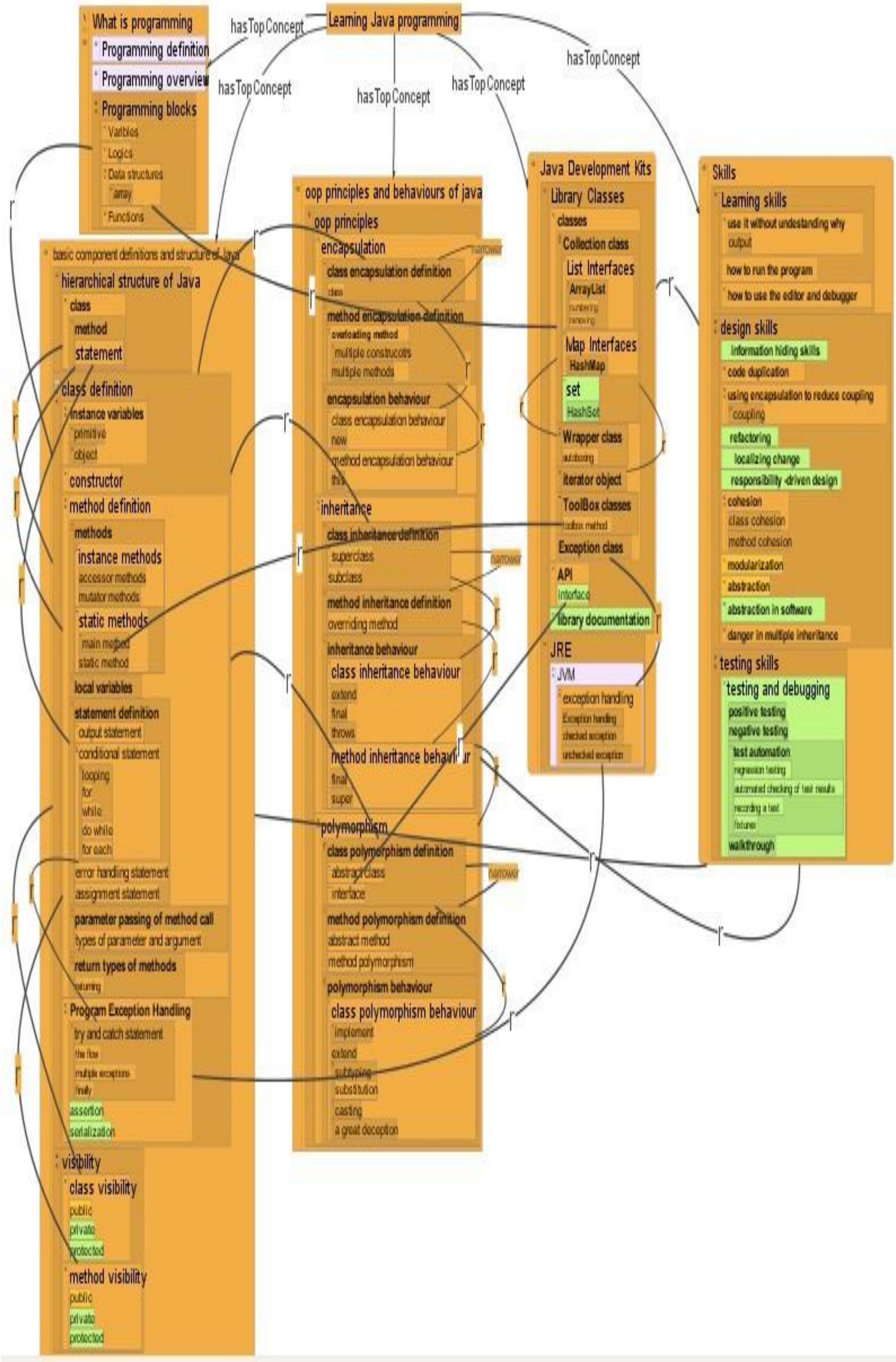

Figure 5-6 SKOS model (Concept map) created based on Java lecture and Book Blue J

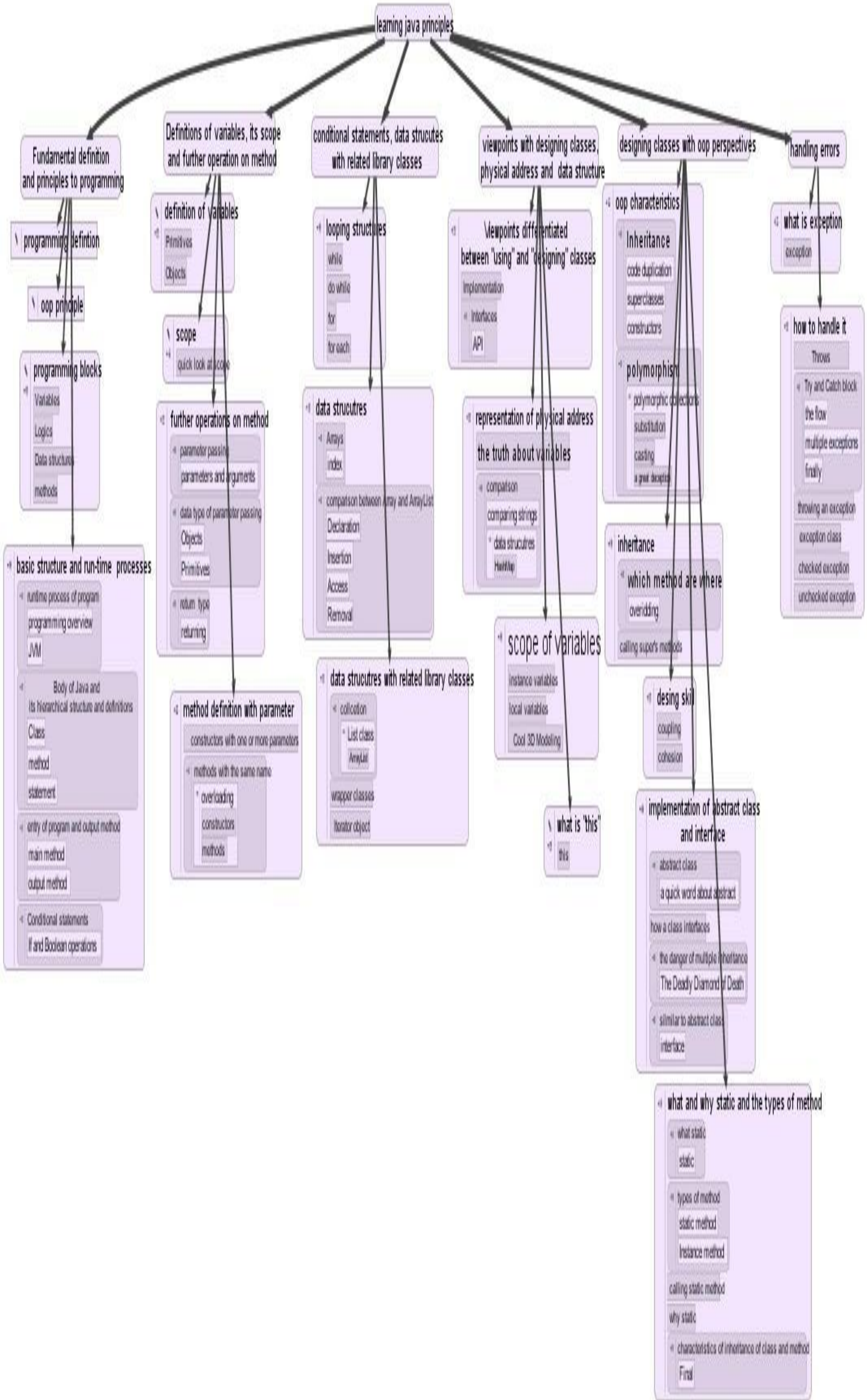

Figure 5-7 Simple Sequencing of Java lectures

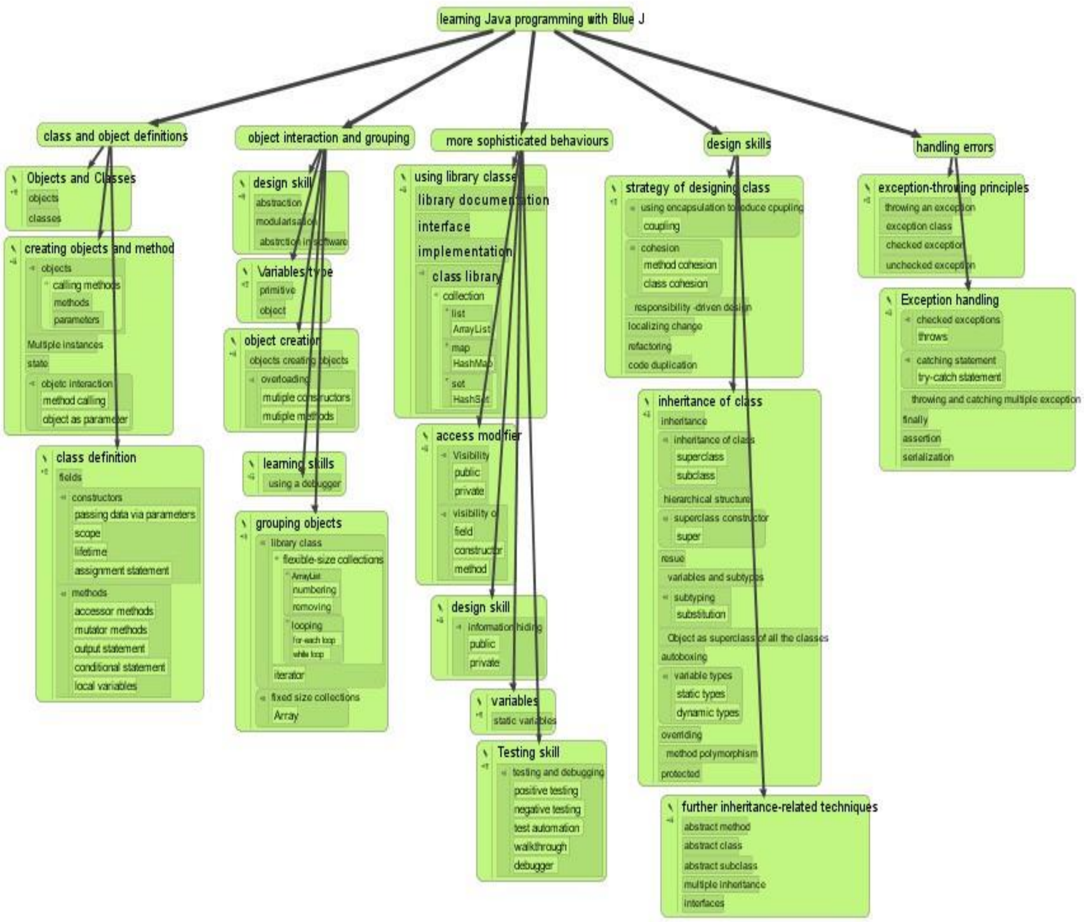

Figure 5-8 Simple Sequencing of Book Blue J

5.7 Analysis and discussion

This concept map created with the SKOS model was supposed to reflect the topics taught in the Java course and book Blue J. This case study was undertaken expecting to see that SKOS model can be used to create a more understandable concept map for individual, self-directed learners, based on its higher organised, and hierarchical structure and to see whether it is conducive to those who are going to start learning programming language and gain a picture of what learning contents, tools and skills need to be learned and learning more effectively and efficiently with an optimal learning sequencing provided.

There were fourteen questions being asked during the expert review, mainly focused on three areas: the quality of instance, the usefulness of built models for students and the appropriateness of models being employed. There are five participants involved in this expert review, shown anonymously (e.g. comments followed by "person X") during the discussion.

5.7.1 Quality of this instance

In order to understand the quality of the concept map and two simple sequences created for this study, several questions associated with the quality of the map were being asked during the interview. Questions and analysis about the quality of this map are discussed respectively in terms of their reality, granularity, consistency, sufficiency, differences (Booch, Rumbaugh et al., 2005).

Reality refers to whether the map is an accurate representation of what actually happens on the course. Interviewees involved in the review had a common agreement that this concept map corresponds well to the course they teach, and the book that they reference.

Granularity refers to whether the given information and knowledge of the created map has sufficient, detailed information.

From the comments given by the participants involved, the appropriateness of the granularity of this concept map depends on learners' knowledge level and the importance of the concepts determined by the course designer (e.g. some concepts are more important and detailed than others).

> *'[Concerning complexity and size of certain branches] It is very difficult to know what is enough and what point would be correct in detail...' – Person C*

> *'It depends on what people would use this for.' – Person R*

Consistency refers to the integrity of the created concept map, for example to ensure that the structure of each concept is appropriately detailed, related, and self-symmetric. Most of comments from the interview agreed that the concept map is self-consistent, although some participants thought that this was too difficult to discern by just examining the map, and could only be shown through a more detailed analysis.

Inclusiveness concerns whether the map contains sufficient information and has enough concepts and relationships, analysis from the comments shows that there is a common agreement on the sufficiency and inclusiveness for the map.

Two simple sequences from the lecture note and book Blue J were given to the participants in order to compare the **differences** between them. Participants found the structures a useful way of representing the order of learning.

'Yes. I think it is a good way to think. They are paths you can take to the material.'- Person E

Participants were also able to easily find key differences between the two approaches by looking at the structures.

'The java course and its simple sequence is more detailed as compared to textbook'- Person H

' The course looks more practical than the book. The feedback was that the book was a bit heavy, very good but heavy.'- Person E

5.7.2 Usefulness

This created concept map is supposed to be conducive to the learner whilst learning programming in Java. Therefore questions about the usefulness for learners were asked during the interview and tried to figure out whether using this model can help learners to understand what needs to be learned and to prepare for subject matters that will be taught in the course in advance.

In order to examine usefulness of this map and the two simple sequences, several questions were discussed during the interview. From analysis of the comments, usefulness for learners would go back to the question of granularity of the concept.

Partly this is because different learners approach learning in different ways and different learning styles, leading to different learning outcomes. In addition concept maps constructed by different people with the same topic may be different according to which of the concepts within the map one holds the most valuable.

'Have you ever shown this concept map to the students with different knowledge level of learning Java programming to see if there is something you need to add in or explain more than just simply giving abstract concepts to them For example, by giving exercises or doing the Lab behind these concepts.' - Person R

Usefulness for the simple sequences was also mentioned during the interview since some of the concepts both cover similar structures of learning orders. It is significant to explore whether there is possible to move or skip from one sequence to other sequence since they both cover the same topics.

From the analysis of the comments, some interviewees agree with that these two simple sequences can be cross-referenced and provide an alternative to the self-directed approach where learner can approach their learning in their own ways.

> *"It can be an extra help, if you are looking for more information about the same concept. For example, the way of description of a method in one sequence can be different from another sequence. Therefore it could be useful to look at a concept at the second time even though [the concepts] designed by different instructional strategies"- Person E*

Others see this from different viewpoints because the same concept in each learning sequence has different assumption and prerequisite which will make it difficult for learners to further understand the fragmental structure over that concept.

> *'Some of them come from different assumption I think it is evident that by seeing this two learning sequences, each [learning sequence] has different pedagogical strategies, design and objectives for achieving a specific or pre-determined learning outcome.' - Person C*

Two learning sequences represent different learning structures and have different educational strategies focusing on different learning objectives. A question with regard to whether seeing the simple sequencing models make it easier to compare the two courses was asked during this interview. From the analysis of the comments, responses associated with this were given and said that there are a lot of different ways to compare them in terms of high level concepts – more general and abstract concepts.

> *' The aim of the lecture is to provide the students initial exposure to Java programming, with the fundamental concepts or skills of learning how to learn [programming in Java], in a sequential, progressive way that make them feel comfortable and confident in learning Java.'- Person C*

‘ The sequence of the content of the book [Blue J] appears to be very cautious and detailed in order to guide the learners through the journey of from the concept of Object-oriented to its relevant, granular sub-concepts such as the technique ‘divide and conquer’ But for the teaching I think it is too much (for students) and time limitation.’ – Person E

Another question related to whether the map created with the SKOS model can help to build another learning sequencing was discussed during the interview. The responses were that semantic relations such as narrower, broader and related relationships, provided by the SKOS model are not detailed enough to organise order of learning.

‘ By looking at this map you constructed with the SKOS model, the ‘related’ relationship does not tell what type of relationship they [the concepts] are if they have prerequisites’. – Person C

5.7.3 The appropriateness of the chosen modelling language

There are many types of modelling languages applied in different disciplines, including computer science, software engineering, and systems engineering (for example, graphical model languages such as Unified Modeling Language (UML) or textual languages) (Booch, Rumbaugh et al., 2005). One of our core questions was whether the SKOS and IMS SS models were an appropriate way to describe the contents and structure of the course and book.

The participants thought that both models were well designed. However one person commented that other relation types would be needed to fully model the course:

“No, because the related relation does not tell you what type of relationship they[the concepts] are if they have requirements or prerequisite” – Person R

None of the participants were aware of other modelling languages that could be used for modelling the course content.

The SKOS model we chose is under the consideration of its ease of use and its organisational structures of representation of concepts in a hierarchical structure and its ‘simply relation rules’ specified by this model. The IMS Simple Sequencing model was chosen for providing a learning order of the subject matters taught in the Java course and book Blue J. Yet the problem with constructing a learning sequence is that the high level terms within the learning sequence (e.g. the most general concepts) often, are somehow difficult to be defined and identified in order to make it clear to understand what sub-concepts will be embraced to further discuss.

> *[It would be good if] the top topics are based on the course and book, then [SS]should be a good approach’ – Person H*

> *‘How do you choose the top level parts of the Simple Sequence?’ – Person C*

Another issue of whether viewing this map created with the SKOS model can help learners construct a learning sequence was discussed to see if this model has the potential of being transformed into a learning sequence. To do this, the SKOS model must provide a mechanism such as prerequisites, which can be used to define the inter-relationship among concepts (e.g. a class must be defined before defining its methods). However in SKOS it does not provide such way to inform learners of what needs to be learned first before going to the next topic discussed.

> *‘I don’t know if looking at that [the SKOS model] would help me to make a learning sequence. But it might be. For example I cannot have a good method unless I teach a class first.’ – Person E*

> *“The ‘related’ relationship does not tell what type of relationship they [the concepts] are if they have prerequisites.”- Person R*

The major problem with SKOS model is that it is used for classification of concepts into an organised structure such as taxonomy, classification schemes, but not for providing further information about the learning order between the concepts.

5.8 Summary

In this chapter, we have explore cognition tools and models such as concept maps, and the SKOS data model and then reviewed existing learning systems and models, which are related to personal learning by looking at which techniques were being used in support of personal learning.

In addition learning-related models, such as IMS Simple Sequencing (SS) has been explored in order to understand how they can be applied to or underpin the design of learning system in a way that can support personal learning. For example IMS SS employs sequencing techniques and related models (e.g. sequencing definition model, tracking model, and activity state model) in order to guide individual learner through the learning objects toward a predetermined learning objective.

We also created a case study related to programming in Java, for examining whether the SKOS data model is an appropriate tool for building a concept map where learners can gain a snapshot of what they are going to learn, and for exploring whether applying the specification of IMS SS can provide a learning model for individual learners to find a learning path to work toward a desired learning outcome.

To do this we constructed a concept map with SKOS data model and two simple sequences with IMS Simple Sequencing model and examined by running an expert review in order to ensure whether these models are useful to be used as a cognition tool which can be used to construct a concept map and two simple sequences for personal learning.

From the analysis we found that SKOS model can give learners a picture of understanding of what topics will be discussed in the process of learning programming in Java but lack of defining a prerequisite to explain some concepts should be learned before or after the adjacent concept to be learned.

In addition we have found that IMS SS does not explain why concepts might be revisited by a learner, and discovered that there may be the issues around how the top level terms of concepts are built.

We have also found that SKOS and SS were capable of capturing the main learning concepts and paths, but that there were issues about the right level of detail, and whether the complexity of the structures might compromise their usefulness to learners.

Chapter 6 Design of a Scrutable Learning System

6.1 Introduction

In this chapter we propose a scrutable learning model approach that allows personal learners to take control of their learning objectives while still allowing the system to intelligently support them with appropriate learning activities and resources.

A simple PLE was designed for a mobile device to see how a scrutable learning model can facilitate independent learners in developing their own learning environment and how they reflect and evaluate their learning in such an environment. A limited prototype was developed as a proof of concept for the design

6.2 Models

To model the learning process in our scrutable AEH prototype we have employed the SKOS (Miles and Bechhofer, 2008) as the data modeling approach for organizing the subject domain (as described in Chapter 5). The SKOS, developed by W3C, is a semantic web language used to describe simple knowledge structures for the web. This approach aims to structure the subject matter content in a hierarchical, graphical representation.

Our prototype application uses SKOS to model the domain of culture shock (our target audience would be international students arriving in the UK). Figure 1 shows an example portion of the SKOS structure developed for this application. It is in effect a simple taxonomy of topics in the domain that we have created by analysing a number of culture shock textbooks and websites. Our model includes top level subjects such as

‘Life’ that are broken down by the ‘Narrower’ relation into sub-topics such as ‘Fitting In’ or ‘Food and Drink’. By associating each SKOS node with appropriate learning activities and resources we can then generate a hypermedia content page for any concept.

The SKOS model is a good way to structure content about the domain, but it does not contain any pedagogical information that might help a learner to navigate those structures. To enable the learning process to be sequenced and personalised by our AEH system we have used another set of models built with IMS Simple Sequencing (IMS, 2003). This is used to model alternative learning paths through the subject domain (as represented by pages generated from nodes in the SKOS graph). Our system uses a single SKOS model but contains many alternative learning paths, in this way it can use a traditional adaptive hypermedia engine to suggest next steps (and related topics) to users when they browse any concept page.

We seeded our prototype with three different Simple Sequences created from a number of source textbooks and online resources. Figure 2 gives an overview of how a set of concepts is organized into a SKOS graph, and then a path through them is created in a Simple Sequencing model.

Node A is sequenced with the rollup rule ‘all’ and its children activities (BCJ) are sequenced with rule ‘any’. This means that Node A is satisfied only if all its children have been visited and satisfied, but B and C can be satisfied by viewing any combination of their children. Therefore, given this simple sequence, the available learning paths through Node A are: ABECGJ, ABFCGJ, ABECIJ and ABFCIJ.

Together the two models can be used to generate links and guidance for students viewing the material. For example, if viewing Node I we can the SKOS model to suggest parent C or siblings G or H, and use the Simple Sequence to suggest moving back to G or forward to J.

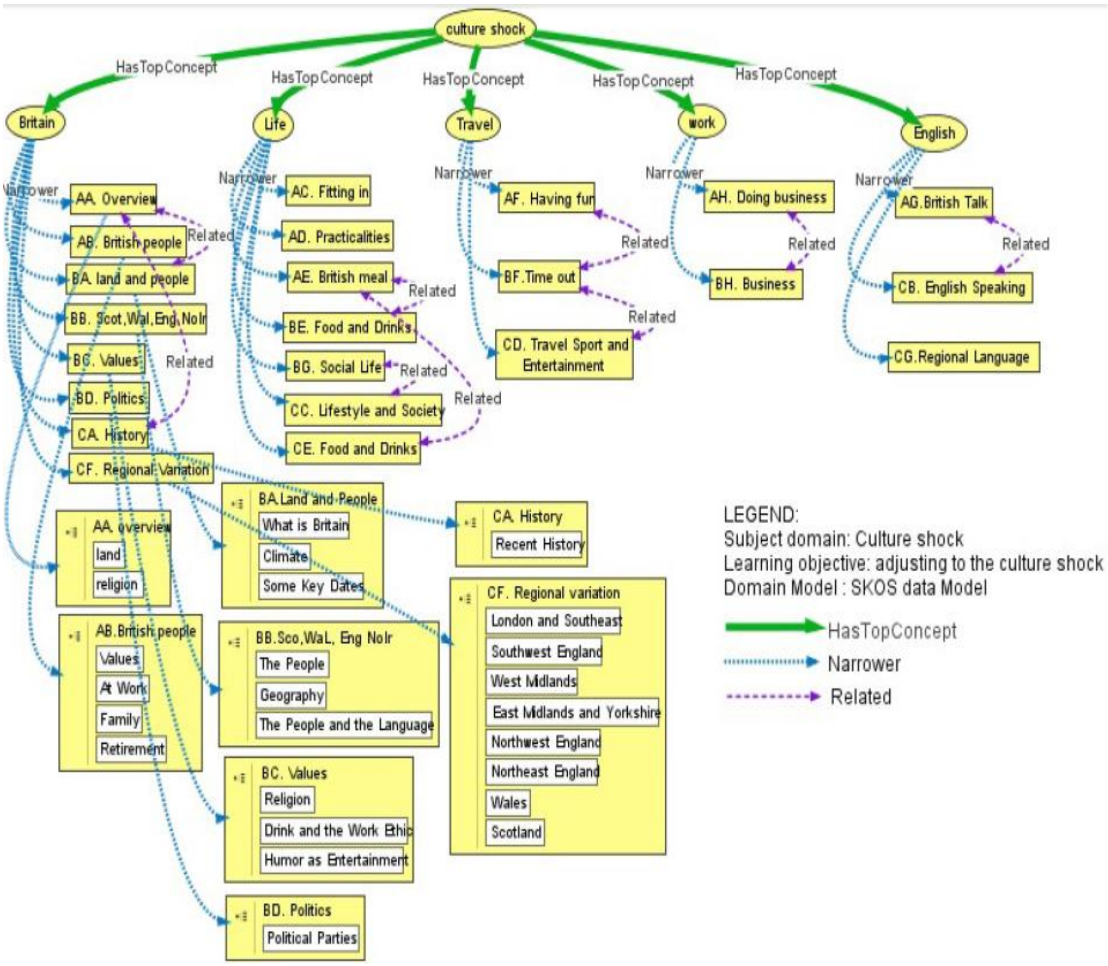

Figure 6-1 An example of graphical representation of learning process modeled in SKOS

6.3 System

To enable our prototype to be run on mobile devices we designed it as a Rich Internet Application (RIA), under the framework of HTML5, CSS3, and JavaScript. The application tools employed for our system development is Sencha Touch, a mobile JavaScript framework, allowing us to develop a web application that simulates the look and feel of apps on the iPhone. We have developed two distinct versions of our system.

The first as shown in Figure 4 is a non-scrutable version that functions exactly as a traditional AEH system. Users navigate concept pages and the AEH engine uses their history, the SKOS model and their current Simple Sequence to suggest next pages and related topics as hyperlinks at the bottom of each page.

The second shown in Figure 5 is a scrutable version that maintains all of the functionality of the first AEH, but also allows users to see visualizations of both the

SKOS and SS models. In this second system users are free to use either the SKOS model or the SS models to jump around the content (or just to orientate themselves). In this way users will be able to see the reasoning behind the hyperlinks offered in the standard content view, and are free to deviate from then at any time (or switch to an alternative learning path). By comparing the user experiences of the two applications we hope to be able to understand the impact of scrutability on personal learner's perceptions of independence.

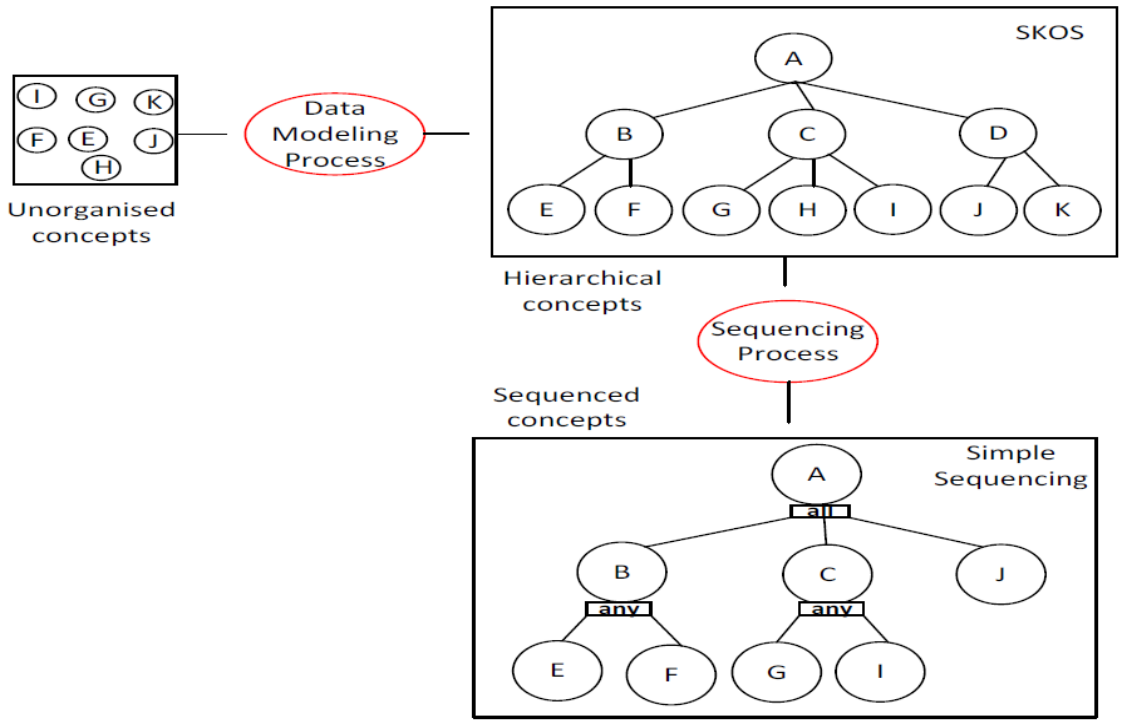

Figure 6-2 An example of possible learning paths to the subject domain

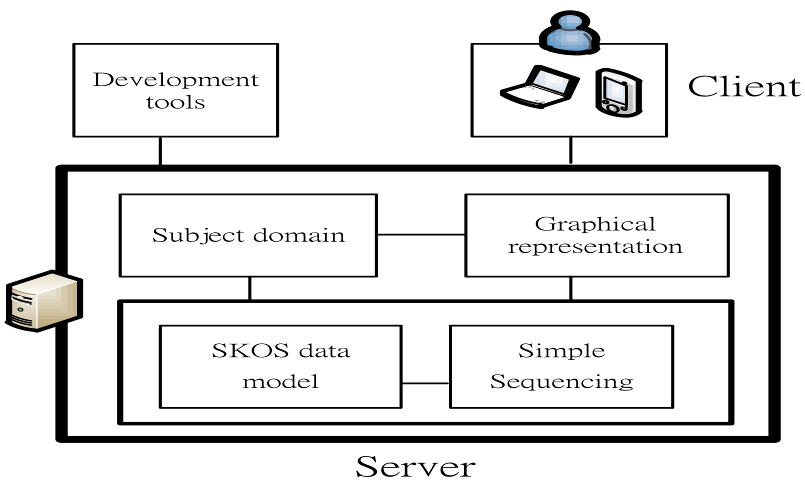

Figure 6-3 Architecture Diagram

A given scenario to explain how our initial prototype might function is as follows:

Valerie is an international student and she wants to explore the cultural difference about local cuisine in the UK. On a free afternoon she decides to use the system to explore a new aspect of life in the UK. She logs into the non-scutable learning system and sees the welcome page. She clicks one of the options (culture shock) to see how the system can guide her through all the learning experience about local culture. After clicking the" ***culture shock****", the system then shows her the British meal with some available and alternative learning paths (as shown in Figure 6-4). The system recommends her some alternative learning experience like "****HavingFun****" and "****TimeOut****". But it seems like traditional hypermedia systems.*

Therefore she decides to login into the scrutable learning system and try to see whether it can provide her with some useful learning information that meets her learning objectives (local culture). When she login into the scrutable learning systems, she finds that there are some differences when compared to the non-scrutable learning system. The scrutable learning system not only gives her the learning paths as given in the non-scrutable version, but also shows her the model behind those paths, thus informing her of the intention behind the information given.

For example the scrutable version provides more options like current path which shows her the current path by a graphical representation as shown in Figure 6-5. Then she can click and expand the scrutable topic map to see what and why the system has guided her through with some explanation. Therefore she can make informed decision about her learning objectives and see how the scutable learning system can help her explore more cultural experience about living in the UK.

*Not only has she been able to personalize her learning activity, but by navigating the models and seeing the available options (*as shown in figure 6-5) *, she has learnt a little bit more about how aspects of British life relate to one another..*

Figure 6-4 Screenshots of the designed system (non-scrutable). Navigation occurs through normal hyperlinks

Figure 6-5 Screenshots of the designed system (scrutable). Hyperlinks are still present, but now users can navigate using the SKOS and IMS SS models as well.

6.4 Summary

In this chapter we presented the idea of a scrutable learning model, which allows intelligent tutoring, while retaining a student’s control of learning objectives and activities. We have also presented the prototype of our system, a mobile web-based application with scrutable topic and learning models (SKOS and Simple Sequencing respectively). We are in the process of finalizing the system and creating models and content from the domain of culture shock aimed at international students coming to the UK.

The intention is to create a system that can support a comparative experiment (non-scrutable vs. scrutable) to understand how a scrutable learning model can affect the learning behaviours of individual learners. Our hypothesis is that it will allow learners to benefit from an adaptive educational environment while maintaining their perceptions of control and choice.

Chapter 7 Conclusion and Future Work

7.1 Summary

This report has described how personal learning might be supported through the use of scrutable learning models.

Chapter Two reviews how learning-related theories underpin educational strategies and pedagogical design, and explores the formality of learning in terms of the context and explores how these learning-related theories are employed to underpin and support the design of different learning activities covering both formal and informal learning.

Chapter Three explores different approaches to building e-learning systems and investigates whether these can be described as supporting informal or self-learning. ***Personal learning*** explores the related issues on digital native and how they apply their own technologies into their lives and studies. ***Mobile learning*** addresses the potential of mobile technology for personal learning with related learning and teaching strategies and application.

Chapter Four proposes a framework relevant to formality of learning for exploring whether current e-learning or mobile learning systems are in the spirit of a PLE or a VLE

Chapter Five explores cognition tools and models such as concept maps, and the SKOS data model and then reviewed existing learning systems and models, which are related to personal learning by looking at which techniques were being used in support of personal learning. A case study was created for exploring whether applying the specification of IMS SS can provide a learning model for individual learners to find a learning path toward a desired learning outcome. This was then evaluated through an expert review.

Chapter Six presents the idea of a scrutable learning model, which allows intelligent tutoring, while retaining a student's control of learning objectives and activities. We have also presented the prototype of our system, a mobile web-based application with scrutable topic and learning models.

7.2 Contribution

The contributions made so far are as follows

1. A 4D model of informal learning – which is a framework presented at m-learn conference (Chen, Millard et al., 2008 A)for exploring the formality of both existing e-learning and mobile learning systems, and analyses whether existing m-learning tools are in the spirit of a mobile PLE or a mobile VLE.
2. The concept of a Scrutable Learning Model- which allows intelligent tutoring, while retaining a student's control of learning objectives and activities.
3. Expert review of appropriateness of SKOS and IMS Simple Sequencing (SS) – which was running with the objectives of exploring whether the SKOS data model can be used as a concept mapping tool for learning how to learn and further providing a learning approach to self-directed learning, and whether IMS SS can provide an optimization learning path to the self-directed learning.
4. Design of Scrutable learning system- prototype of our system, a mobile web-based application with scrutable topic and learning models (SKOS and Simple Sequencing respectively).

7.3 Publications

1. Chen, Wen-Pin, Millard, David and Wills, Gary (2008 A) A Four Dimensional Model of Formal and Informal Learning. In, The 16th

International Conference on Computers in Education, Howard International House Taipei, 27 - 31 Oct 2008.

2. Chen, Wen-Pin, Millard, David and Wills, Gary (2008 B) Mobile VLE vs. Mobile PLE: How Informal is Mobile Learning? In, mLearn 2008 Conference, the University of Wolverhampton, 08 - 10 Oct 2008.

3. Chen, Wen-Pin, Millard, David E. and Wills, Gary B. (2011) Using Scrutable Learning Models to Support Personal learning Objectives on Mobile Devices. In, The PLE Conference 2011, Southampton, UK, 11 - 13 Jul 2011.

7.4 Future Work - A Scrutability Experiment

The future work would be to conduct an experiment to explore whether the presented scrutable learning model of a subject domain and alternative learning paths through that domain can allow individual learners to make informed decisions about their learning objectives and then support them with appropriate learning activities and resources, while retaining the spirit of a PLE.

In this experiment participants would be divided in two groups: experimental group and control group.

Participants in Experimental group are assigned to the use of the system developed with scrutable learning model. The others in Control group are appointed to the operation of the system non-scrutable learning model. The plan for the experiment would be as follows:

Participants:

Target users for this experiment are HE learners or international students who might be interested or already have experiences in self-directed learning.

Subject domain:

The focus of this research is on personal learning, and thus the chosen subject domain will be informal and intentional in a real life context. In this research we choose a popular topic “culture shock” as our research subject because it is relatively informal, and happens in everyday learning activities.

Context:

Since this research aims to build up a PLE, we implement a web-based learning application, based on a presented scrutable learning model, and test it in informal settings. Testing methodology is that the participants are required to do a learning task with the application, engaging with it wherever they like (might be at school settings or away school), finishing in a given time and then coming back school for a test which is relevant to the subject materials they have learned from that task, or a questionnaire about survey.

Quality for model:

To ensure that this model is in a sufficient, acceptable quality design and not affect the result of this experiment, expert review approach will be taken to review the designed model before going to the deployment of the system to the participants.

Presentation of model and resources:

User-led design approach will be used to review the presentation of the model in a way that the given form of representation of the model/resources will not affect the result of the experiment.

Independent variable is the type of presented learning system, composed of two levels

1. Non-scutable

   A presented system that is developed with a non-scrutable learning model in this study

2. Scrutable

   A presented system that is developed with a scrutable learning model

The dependent variable is the individuals learning behaviours. Such behaviours are then evaluated by answering a questionnaire that is comprised of several high level goals as follows, where each item is represented by questions rated on a five-point likert scale.

- Item1: the scrutable learning system's usefulness
- Item2: its effectiveness
- Item3: the satisfaction of participants
- Item4: the system allowed me to control of learning process
- Item5: the system allowed me to be free to go through the presented content resources
- Item6: degree of Achievement of learning objective
- Item7: completeness of subject matter content
- Item8: clearness

The objective would be to include forty participants from international students coming to the UK in the experiment. The experimental process is as follows:

1. Introduction: participant would be informed of what the purpose of the experiment is
2. Administration: a consent form for each participant to ensure that they are voluntary to take part in the experiment.
3. Tasks: using the (scrutable or non-scrutable) system that is assigned to them
4. Questionnaire: questionnaire is given while finishing the task

7.5 Conclusion

A 4D model of formality in e-learning systems or mobile learning systems is developed in order to explore whether existing mobile learning research is more in the spirit of PLEs or VLEs. This model has revealed that students are rarely in control of their learning goals and process.

To explore the whether a learning system can be scrutable to help learners to manage and control their learning process, we designed a scrutable learning model and a prototype was created to understand how a learning process can be scrutable by showing independent learners the intention or goals behind a given learning activity, instead of merely guiding them through the journey.

A scrutable model may only be partially visible to users, i.e. they would understand how it works and why. In other words, they can partially see through it, i.e.

they can understand and see parts of the model, but more complex parts (that would not be helpful to them) remain hidden.

The hope is that with the scrutable learning model independent learners can freely monitor their process of learning activities and get a better understanding of what to do and how to do it better with the advice provided by the system, whilst still feeling in control of the entire learning process.

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Chapter 9 Appendix A

PART ONE:

Qutestion1: This concept map created with the SKOS model is supposed to reflect the topics taught in Java course and Book Blue J. Do you think that this model captures the reality of these two courses?
Answers or comments for the question provided by teaching and support staff are given as below : 'Yes.' – By E 'Yes. But something taught in the lab will not be in the course. It covers almost everything on here which is covered by our course. We did do some testing, design, learning skills' – By R 'Yes. It looks pretty good.' – By C. 'Yes. Everything is there'– By T 'Yes. Everything is covered in the course'– By H.

Question 2. Do you think concept map has the right granularity to represent these two courses?
Answers or comments for the question provided by teaching and support staff are given as below : 'Yes. When you describing it to me. I think it is a good way to show the students what is going on here without just saying anything like this, like this. You represent a lot of abstraction which I think it is extra help for them instead of just describing in the book or the lecture note.' – By E. 'Yes. There is something here which gets a lot of teaching, a very important part of the course…… take for example learning skills such as testing skills, debugging skills...... that whole section thing is much bigger than conditional statement. It is very difficult to know what is enough and what point would be correct in detail.....' – By C 'Probably. It depends on what people would use this for.' – By R 'Yes'– By T 'Maybe. It depends on who is using this map. I think for students they may want more information if it is for student use. But if someone who is familiar with them is looking at this I think it is a good presentation.' – By H

Question 3. Do you think this SKOS model is “self-consistent”? (i.e. does it consistently have the same level and detail)
Answers or comments for the question provided by teaching and support staff are given as below : ‘ I don’t know’– By H ‘Yes. I think so’– By T ‘I don’t know. You have to prove it’– By E ‘Yes’– By C ‘Yes’– By R

Question 4. Do you think that showing learners this SKOS model would help them to understand what needs to be learner at the beginning of learning Java programming?
Answers or comments for the question provided by teaching and support staff are given as below : 'It will help. It is two ways of looking at these things. One is that there are no shortcuts that you have to write the java code. As a concept map itself. It is meaningless unless adding the coding practice into the concept map. It is a sound of education'– By E 'I don't know how useful it is at the beginning I think this will go back to the granularity again'– By H. 'Not this model'– By T. 'I think so. I think the depth has gone to the granularity does give you list of each of the topic you learn along the way. Have you ever shown this concept map to the students with different knowledge level of learning Java programming, to see if there is something you need to add in or explain more than just simply giving abstract concepts to them? For example, by giving exercises or doing the Lab behind these concepts. ' – By R 'I don't think so.' – By C

Question 5. Do you think that the semantic relations provided by the SKOS data model are enough to express the relationships among concepts? (e.g. narrower, broader, related semantic relationships)
Answers or comments for the question provided by teaching and support staff are given as below : ‘Yes. I think so’– By H. ‘Yes’– By T ‘Conceptually it is very good. Practical they have to do the lab. It is a good handle. It looks good to me’– By E. ‘No’– By C ‘it depends on what this model is used for’– By R

6. (a) Do you think it is appropriate that alongside the SKOS model there is a complimentary learning skills map? (b) Are there any other maps we have failed to include? If yes, what are they?
Answers or comments for the question provided by teaching and support staff are given as below : 6a. 'Yes'– By H 6b. 'I think it is very objective if you are of the course. I don't know it cover where. I am not sure. It is about what the common topics are covered in the course'– By H. 6a. 'Yes. It is really important'– By T 6b. ' I think there may be other maps you can use'– By T 6a. 'Yes. – By E 6b. ' I don't know'– By E 6a 'Yes'– By C 6b. 'No'– By C 6a. 'Yes'– By R 6b. ' No' – By R

PART TWO:

Question 7. Is the simple sequencing structure a good way to represent the order in which things are taught in the course?
Answers or comments for the question provided by teaching and support staff are given as below : ‘Yes. [It would be good if] the top topics are based on the course and the book, then [SS] it should be a good approach.’ – By H ‘Yes. It looks quite good if you put the rules on the simple sequencing structure.’ – By T ‘Yes. I think it is a good way to think. They are paths you can take to the material. It is a good way’– By E ‘Yes.’ – By C ‘Yes.’ – By R

Question 8. What do you think are the key differences between these two simple sequences?
Answers or comments for the question provided by teaching and support staff are given as below : 'The java course and its simple sequence is more detailed as compared to textbook'– By H. 'The course looks more practical than the book. The feedback was that the book a big heavy, very good but heavy.' – By E 'There are a lot of differences. The order of things, on that course we start with a very basic structures, and basic things like variables, method and class…the ordering of things is different because the focus of each one is likely different'– By R 'How do you choose the top level parts of the Simple Sequence? The book purely teaches Java, the focus of our course is on teaching the basics of programming to fresh university students. Because of teaching that basics of programming, although we cover the thing which maybe the book would not cover. Our framework of explaining in a more context of learning helps programming.' – By C.

Question 9. Do you think it would be possible for students to move/skip from one sequence to other sequence since they both cover the same topics?
Answers or comments for the question provided by teaching and support staff are given as below : 'Yes. It depends on the modular design'– By H 'Yes, It can be an extra help, if you are looking for more information about the same concept. For example, the way of description of a method in one sequence can be different from another sequence. Therefore it could be useful to look at a concept at the second time even though [the concepts] designed by different instructional strategies. I think you could make a good case which says we should try to make them do in different sequences to, because sequences shouldn't matter I take you through a sequence one way and then I take you to another way, it should be better for you, because you can see that. Actually you can see what you need to know can be learned'– By E 'Yes. – By T. 'No, because some of them come from different assumption, I think it is evident that by seeing this two learning sequences that each [learning sequence] has different pedagogical strategies, design and objectives for achieving a specific or pre-determined learning outcome."' – By C 'No'– By R

Question 10. Do you think that seeing the simple sequencing models makes it easier to compare the two courses? If yes, why do you think?
Answers or comments for the question provided by teaching and support staff are given as below : 'Yes. They have similar structures.' – By H 'It is hard to say. The sequence of the content of the book [Blue J] appears to be very cautious and detailed in order to guide the learners through the journey of from the concept of Object-oriented to its relevant, granular sub-concepts such as the technique 'divide and conquer' But for the teaching I think it is too much (for students) and time limitation.'" – By E 'Yes. a lot of different ways to comparing them'– By T 'The aim of the lecture is to provide the students initial exposure to Java programming, with the fundamental concepts or skills of learning how to learn [programming in Java], in a sequential, progressive way that make them feel comfortable and confident in learning Java.' – By C 'It is not so easy. It is about the granularity again'– By R

Question 11. Do you think that using the SKOS model could help to build another learning simple sequence? If yes, how to help? If no, why?
Answers or comments for the question provided by teaching and support staff are given as below : ‘Probably’– By H ‘I don’t know if looking at that [the SKOS model] would help me make the learning sequence. But it might be. For example I can not have a method unless I have a class so I should teach a class first. Yes. It is possible to use the skos model to devise learning simple sequencing.’ – By E. ‘Yes.’ – By T ‘No. By looking at this map you constructed with the SKOS model, the ‘related’ relationship does not tell what type of relationship they [the concepts] are if they have prerequisites.’ – By R ‘No, because the related relation does not tell you what type of relationship it is if they have requirements or prerequisites. If you can say this has to come before that and that has to come before that.’ – By C

Question 12. Do you think there are alternative concept maps or modeling approaches which could make it easier to display a clear whole picture of learning Java programming? If yes, what are they?
Answers or comments for the question provided by teaching and support staff are given as below : 'It is about visualisation. I am not sure, I probably use the ontology for doing that'– By H. 'Probably 3D representation.' – By T 'I have no idea' – By E. 'Quite possibly, but I have that background' – By C. 'I don't know about it, I mean you can draw a nice mind map of the course that might help you visualise better.' – By R.

Question 13. (a)Do you think that the simple sequencing model is rich enough to cover what is being taught? Are there other structures we could use to order the topics taught in the Java lectures and Book Blue J? If yes, what are they?
Answers or comments for the question provided by teaching and support staff are given as below : 13a. ‘Yes. I think so’ – By H 13b ‘I think tree structure is a good approach to expressing this’ – By H. 13a. ‘Yes. It could be more detailed’– By T 13b. ‘ no idea’ – By T 13a. ‘I don’t know other models. But it should be o.k.’ – By E 13b. ‘ I don’t know’– By E 13a. ‘Yes, probably, the structure is definitely enough. But how you implement the structure is different.’ – By C 13b. ‘I don’t know, maybe there are other structures.’ – By C 13a. ‘Yes. But the simple sequencing does not tell you the related relation’ 13b. ‘I don’t know any others…… but I will use simple sequencing’– By R

Question 14. What happens if we revisit the concept within the simple sequencing model? Do we need to capture the difference between the two occurrences? (i.e. the given concept ‘method’ shown in different clusters)
Answers or comments for the question provided by teaching and support staff are given below : 14a. ‘I have no idea’– By H. 14b. ‘Yes. It will be helpful. If you do not understand at the first time, then you can review it later’– By H 14a. ‘It depends on the instructional strategies.” – By E 14b. ‘It is necessary to capture the difference and is useful’– By E 14a. ‘If they did not understand at the first time, you can ask them to learn from different angles’– By T. 14b. ‘Yes, it is necessary to capture the reference because people approach learning in different angles.’ – By T. 14a. ‘I have no idea’– By C 14.b ‘Yes’– By C 14a. ‘You don’t normally go back to previous node, if you have another node, the first one is method the next one is extending method or overloading method, it is different node you teach in different things even it is related to each one. Simple sequencing does not know about the related relation. It is o.k. the separated nodes, not the same things’– By R 14b. ‘Yes’– By R