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Towards a sustainable open educational resources development model: Tapping into the cognitive surplus of student-generated content

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DEDICATION

I dedicate this thesis to my husband and best friend Ala Malhis.

Ala,

You’ve been my true source of motivation

and a shoulder to lean on

You stood by me through up and down until the end

and gave me love that led the way

Thank you for your patience, devotion and support that has never ceased

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Finally, to my parents Mazin and Raefa, my husband Ala and my children Adam and Sophia, thank you for your love and support.

STATEMENT OF AUTHENTICATION

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

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ABBREVIATIONS

CFA	confirmatory factor analysis
COL	Commonwealth of Learning
DBR	design-based research
EFA	exploratory factor analysis
FOSS	free and open source software
HEFCE	Higher Education Funding Council for England
ICDE	International Council for Open and Distance Education
ICT	information and communication technologies
IT	information technology
JISC	Joint Information Systems Committee
KMO	Kaiser-Meyer-Olkin
MIT	Massachusetts Institute of Technology
MIT-OCW	Massachusetts Institute of Technology OpenCourseWare
MOOC	massive open online courses
NGO	non-government organisations
OCW	OpenCourseWare
OECD	Organisation for Economic Co-operation and Development
OEP	open educational practices
OER	open educational resources
OERu	Open Education Resource University
OLT	Office of Learning and Teaching
OPAL	open educational quality initiative
PCA	principal component analysis
PPMCC	Pearson product-moment correlation coefficient
SCEM	School of Computing, Engineering and Mathematics
SPSS	Statistical Package for Social Sciences
TELE	technology enhanced learning environment
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organization
UWU-OCW	Utah State University-OpenCourseWare
vUWS	virtual learning management system of WSU
WSU	Western Sydney University

ABSTRACT

Open Educational Resources (OER) have created opportunities for learners around the world. Previous research investigated different OER development models for higher educational institutions and other educational communities. However, maintaining sustainability remains the main challenge of OER projects, as there is a high demand on raising awareness of the value of OER in higher education, as well as the need for expanding a participation base in the OER development process and improving the quality of OER. As a response to these challenges, the research documented in this thesis presents a new OER development model that establishes communities of practices around OER in higher educational institutions, where the knowledge production that takes place inside classrooms provides sustainable resources for the OER development process. OER literature also shows initiatives on engaging students in the OER development process, however, there is a lack of rigor research that shows the principles of engaging students in this process. Hence, this study is focused on identifying the design principles of the sustainable OER development model that engages students in generating OER.

The model was designed to establish communities of practice of students and teachers to work collaboratively in generating learning resources. In the context of computing and information technology studies for undergraduate learning environments, students generate a surplus of projects in different study units with some projects repurposed, however, a surplus of projects that are generated on every academic semester are rarely tapped into. This abundance of knowledge production is described as ‘cognitive surplus’ and tapping into it can maximise the value of these projects.

Therefore, the proposed OER development model taps into the cognitive surplus of student-generated content, where instead of generating summaries and portfolios, students create learning resources based on the unit topics using content authoring software tools. In this model, teachers work as facilitators and co-creators, providing evaluation of learning resources in order to be published as OER. To engage students in generating learning resources for OER, the learning assessment approach was taken from assessing student projects on reproducing information to a new level where students engaged in structuring, designing, collecting and evaluating content for generating learning resources which was then shared online as OER. These activities maximised students’ responsibilities, because sharing work online motivated them to improve the quality of the learning content.

To be able to design a new OER development model, there was a need to understand the characteristics of the learning environment, including students, teachers and the learning material. In addition, developing a pedagogically informed approach to adopt the OER development model in learning environments, which can help with improving students' learning performance and advance the teaching practices through open educational practices (OEP), was also required.

Therefore, to fulfil these requirements, this thesis elaborates on the literature review of the related areas of the OER development model and provides analysis of the emerging concepts and related theories. The thesis also presents and reflects on the stages of model development, refinements and evaluation over the lifetime of the study, and provides practical evidence on the potential sustainability of the model in real-life learning environments.

In order to evaluate the model in real life settings, the design-based research (DBR) methodology was adopted to guide the research development and implementation. The methodology was conducted over three iterations: (i) starting stage (Iteration 0); (ii) growing stage (Iteration 1); and (iii) adapting stage (Iteration 2), where each iteration consisted of four phases. During each iteration stage, Phase One focused on analysing existing problems in literature reviews and real-life educational settings, Phase Two helped with proposing the initial design principles based on recommendations from Phase One and adjusting the setting of the educational environment, and Phase Three consisted of iterative cycles of testing and evaluating the solution in a real-life setting at undergraduate study units. Phase Three consisted of one cycle in Iteration 0 (Cycle 1) and Iteration 1 (Cycle 2) where in Iteration 2 there were three cycles (Cycle 3, Cycle 4 and Cycle 5). Each cycle represents the integration of the proposed solution into one study unit in the School of Computing, Engineering and Mathematics at Western Sydney the University. The iterative nature of the DBR methodology helped with refining the design principles of the OER development model. Phase Four was the last phase of each iteration where reflection of the results, refinement of the solution and documentation of the research process took place and helped with generating the final design principle of the OER development model. At the end of the research, 10 reusable design principles of the proposed solution were culminated and recommended, as follows:

Principle One: Six elements of OER models. Principle One presents six essential elements of OER development models.

Principle Two: Understanding the initial launch of OER projects. Principle Two provides directions on the initial establishment of a new OER development project in higher educational institutions.

Principle Three: Student-generated content becomes the OER. Principle Three recommends that student-generated content be effectively repurposed in the OER development process.

Principle Four: Pedagogical framework and essential learning activities in the OER development process. Principle Four describes a set of constructive learning activities to support the learning process through generating OER.

Principle Five: Utilising Web 2.0 in the OER development process. Principle Five recommends the use of Web 2.0 tools in the OER development process as these tools provide effective means for communities of practice of students and teachers in generating and publishing learning resources.

Principle Six: Evaluating criteria to assess the fitness of student-generated learning resources to OER. Principle Six summarises a set of evaluation criteria that is required to assess the fitness of learning resources generated by students to OER.

Principle Seven: Learning scaffolding in the OER development process. Principle Seven recommends the learning scaffolding that is required for students to support them in the OER development process.

Principle Eight: Learning assessment in the OER development process. Principles Eight underpins the role of the learning assessment as an essential part in the OER development process in order to monitor the learning progress for students

Principle Nine: Role of the teaching team in the OER development process. Principle Nine emphasises the anticipated characteristics of the teaching team in the OER development model.

Principle Ten: Integrating the OER development model into a study unit. Principle Ten emphasises that integrating of the OER development model into study units needs to be tailored based on the knowledge type.

The set of design principles of the OER development model provides a reusable artefact for other higher educational institutions to initiate OER projects and participate in supporting openness and OEP in higher education. Finally, the return on investments in open education projects can lead to further benefits beyond academia, including improved quality of life for students as they develop significant employability skills of generating online content, economical impact for students and institutions in cutting the cost of educational material, and established online presence for the university in the open education world.

CHAPTER ONE: INTRODUCTION

1.1 Open educational resources

This thesis focuses on open educational resources (OER) in higher educational institutions. OER are defined by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as ‘teaching, learning or research materials that are in the public domain or released with an intellectual property license that allows for free use, adaptation, and distribution’ (UNESCO, 2014). Additionally, UNESCO views OER as providing ‘a strategic opportunity to improve the quality of education as well as facilitate policy dialogue, knowledge sharing and capacity building’ (UNESCO, 2014). The definition of OER by UNESCO is based on the work of Atkins, Brown and Hammond (2007) that extends on the types of OER that include ‘full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge’ (Atkins, Brown, & Hammond, 2007, p. 4). The ubiquitous information and communication technologies (ICT) and the wide proliferation of the internet have facilitated the production and dissemination of OER and expanded the global access for education (OECD, 2007a).

OER are causing considerable attention around the world due to their promising path of advancing knowledge and improving online access to learning resources. Organisations such as UNESCO, Organisation for Economic Co-operation and Development (OECD) and International Council for Open and Distance Education (ICDE) are collaborating in projects such as the open educational quality initiatives (OPAL) to advance the OER adoption in formal and informal learning (Falconer, McGill, Littlejohn, Boursinou, & Punie, 2013). From an international perspective, demand is expected in the area of open learning innovations, including OER and open textbooks, and massive open online courses (MOOC) will rise enormously in formal and informal education, as there will be more initiatives and projects to take place in the next few years from different individual countries (Jacobi, Jelgerhuis, & Van Der Woert, 2013).

Learning resources published via OER are normally developed by either educators in educational institutions or community members. In the last decade, OER have been widely used in learning and teaching, and there are now well established communities interested in producing, using and researching OER (Gráinne, Conole, McAndrew, & Shum, 2010). A number of formal and informal OER initiatives have been launched. An OECD report showed a growing interest in sharing educational content by over 300 universities worldwide (Trenin, 2007). Massachusetts Institute of Technology (MIT) was one of the early adopters of the OER movement through the OpenCourseWare (OCW) initiative. MIT started its initiative in the belief that by making its courses available for all types of learners, it would help in advancing knowledge and improve the life quality for these learners (MIT-OCW).

A number of studies showed interest in investigating why universities would want to share their educational contents freely and openly, and the challenges associated with doing so (Arendt & Shelton, 2009; Downes, 2007; Hodgkinson-Williams, 2010; Wiley, 2007). The Cape Town Open Education Declaration stated that

> *… this emerging open education movement combines the established tradition of sharing good ideas with fellow educators and the collaborative, interactive culture of the internet. It is built on the belief that everyone should have the freedom to use, customize, improve and redistribute educational resources without constraint.* (Cape Town Open Education Declaration, 2008)

Additionally, well-designed OER projects proved to increase enrolments, widen universities' reputation, improve universities' role in the community and attract research funding when publishing research results openly via OER (Commonwealth of Learning/UNESCO, 2011).

However, even though there is a general theoretical understanding of the benefits of openness in higher education, there remains a lack of adoption of OER in learning and teaching (Atenas, Havemann, & Priego, 2014). Integrating OER in higher education has been challenged by a lack of awareness of openness in higher education, a lack of participation by academics due to limited funding and concerns of intellectual property issues and quality of learning resources published as OER (D'Antoni & Savage, 2009; Pawlowski & Hoel, 2012). Therefore, the concern of OER sustainability emerges among the current endeavours and OER literature.

Raising awareness, participation and quality are important areas for the sustainability of most OER initiatives, mainly when these projects take place in higher educational institutions and rely on seed funding. There are also concerns about OER sustainability due to a lack of investment that is considered the most important future concern (Falconer et al., 2013).

Therefore, alternative OER development models are required to address these issues. With existing OER development models, sustainability of OER initiatives remains the most challenging issue for higher educational institutions (Bossu, Brown, & Bull, 2012; Falconer et al., 2013).

The above challenges represent a complex educational technology problem for the adoption of OER in higher education. This thesis provides evidence that a new OER project can continue to operate and provide its services based on sustainable resources of knowledge production. Such resources are found in abundance in higher educational institutions where students produce knowledge through project-based learning approach. A new OER development model can be designed to tap into this type of knowledge production. However, to provide practical evidence of potential sustainability, a new OER development model requires understanding of how it works in real-life educational settings. Hence, proposing a new sustainable OER development model requires adopting a research methodology that allows the solution in a real-life context to be tested.

As a response to this call, the research documented in this thesis has adopted the DBR methodology for its pragmatic and iterative nature, as well as for its suitability for research in educational technology (Wang & Hannafin, 2005). The adoption of a DBR methodology leads the researcher to generate a set of design principles that address the identified problems in educational settings and contribute to the theory (Barab & Squire, 2004). This thesis proposes the design principles of a new OER development model, which aims at sustaining OER development in higher educational institutions through adopting the model in technology enhanced learning environments (TELE).

In addition to addressing the above mentioned OER challenges, the research is also aimed at enhancing teaching and learning approaches at undergraduate studies in the area of computing and information technology. A project-based learning approach has been adopted widely in computing and information technology courses and has resulted with an abundance of student-generated content. Unfortunately, student projects remain as archives at the end of academic semesters, and tapping into these projects has potential to advance learning and teaching (Bates & Galloway, 2013; Lee & McLoughlin, 2007; Pérez-Mateo, Maina, Guitert, & Romero, 2011).

Therefore, the proposed OER development model in this thesis is two-fold: (i) it shows how to address OER challenges through introducing academics and students to the role of OER and openness in higher education, engaging them in the OER development process to overcome funding and lack of participation barriers, and developing an evaluation strategy to generate quality learning resources; and (ii) it enhances learning and teaching approaches in computer science and information technology undergraduate studies through tapping into student-generated content and repurposing it towards building quality learning resources and sharing these resources as OER.

The model has been designed, developed and applied over three academic semesters at the School of Computing, Engineering and Mathematics (SCEM) at the Western Sydney University (WSU), New South Wales, Australia. The name of the university has been changed during the final stage of the research reported in this thesis, therefore some of the references and the documentations resulted from the research still have the old name of the university, which was University of Western Sydney (UWS). The final design principles of the OER development model can be reused in similar educational settings to generate OER and sustain OER development in higher educational institutions.

1.2 The problem

The literature of OER highlights the sustainability of OER projects as a major challenge for adopting OER in higher education. Under the wide umbrella of sustainability, three important challenges are significant for OER in higher educational institutions: (i) a lack of awareness of the value of OER and openness in higher educational institutions (D’Antoni & Savage, 2009; Pawlowski & Hoel, 2012); (ii) a lack of participation to OER development process and the need to find new participants in the OER development process by exploring roles for students in generating and publishing OER (Atkins, et al., 2007; McGill, Falconer, Dempster, Littlejohn, & Beetham, 2010; Wiley, 2007); (iii) and concerns about the quality of learning resources published as OER and their associated learning design (Bates, 2011; Camilleri, Daniel Ehlers, & Pawlowski, 2014; Ehlers, 2011; Hodgkinson-Williams, 2010; Hylén, 2007).

Major OER projects are available from higher educational institutions and widely used throughout the world. However, while some institutions recognised OER as the future of learning, other studies highlighted major challenges facing OER initiatives which threaten their long-term success (Clements, Pawlowski, & Manouselis, 2015; Hodgkinson-Williams, 2010; Hylén, 2006). For example, the Open Society Institute raised the concerns that governments and educational institutions are unaware of the benefits of open education and require practical evidences of the benefits. A lack of awareness of the benefits of OER in higher education maintains top priority in the OER barriers list, as this barrier continues to emerge among literature of OER. Perhaps the lack of awareness of the value of OEP and utilising them in higher education for learning and teaching, as well as the lack of institutional polices for adopting OEP and OER have made many higher educational institutions reluctant to establish their own OER projects. Other academics in higher education also have concerns about the misuse of their intellectual property if it was made available for use and reuse (Pawlowski & Hoel, 2012). The situation appears to be similar in Australia, as limited OER initiatives have taken place in Australian universities (Bossu et al., 2012; Elliott, 2015). Additionally, the same challenges were identified in the context of Australian higher education for the adoption of OER and OEP, Bossu et al. (2014) have identified the lack of interest in creating and adopting OER, the poor quality of OER resources available, lack of institutional funding and copyright and intellectual property policies issues as major challenges that limit the adoption of OEP and OER in Australia.

A lack of participation in the OER development process and the need to find new stakeholders who can contribute their knowledge and time is a very important challenge facing OER sustainability. Human resources are essential in driving the knowledge construction process and guiding it, as the OER development process requires qualified participants to be available in the knowledge area, at the same time possessing the skills on using content authoring software tools to build the learning resources. Furthermore, finding qualified personnel who are willing to contribute and share intellectual production openly is a challenging factor. Therefore, financial motivation is crucial among OER projects to encourage participation. Many OER projects rely on financial grants, either through hosting institutions, governments or individuals. However, other projects unable to continue due to a lack of funding (Falconer et al., 2013; Friesen, 2009) or when it ceases, there is a need for alternative solutions. Most importantly, the largest cost is generally spent on the staff involved. For example, in 2007-2011, MIT-OCW allocated 49% for staff involved in its project, that is, US$4,300,000 each year (Wiley, 2007). Therefore, financial barriers are a significant reason behind a lack of participation in OER development process by faculty members in higher educational institutions.

The quality of OER is also significant for OER sustainability. Clements et al. (2015) argued that many OER and learning object repository projects failed to attract users and remain sustainable due to a lack of quality assurance approaches that adjust the quality of learning resources. Addressing quality is not an easy challenge, particularly where educational accuracy and learning design standards need to be met. In openly published learning resources, a large proportion of the learning content is available in text format, such as Adobe PDF files, Microsoft Word documents, plain HTML pages and Microsoft PowerPoint slides filled with text content. In addition, a lack of interactivity and engagement with the learner can make these learning materials boring. Therefore, there is a need to find new ways of developing interactive OER easily and canvassing at a quicker pace.

The focus of the research documented in this thesis is to provide a solution to addressing the challenges of OER in higher educational institutions through finding alternative sustainable resources for the OER development process. Therefore, as the focus of the research in OER in higher education, finding alternative resources within the same context is of extreme importance. To investigate alternative resources is to focus on the availability of the human factor and knowledge development process. Therefore, student-generated content was the focus for investigation.

Student-generated content has been known as an essential component of the learning process (Sener, 2007) where students generate projects, assignments, essays, reports and artwork. However, there has been a concern regarding effective examples of student-generated content in the area of higher education (Bull, 2008; Sener, 2007). Even students have generated many projects, tapping into them after the end of the academic semester is an area that requires careful consideration. In this thesis, student-generated content is described as a type of the cognitive surplus (Shirky, 2010) that takes place in learning environments. The term, 'cognitive surplus', emerged to describe the huge number of free-time hours that people spent on the internet by being engaged with different online activities. The proliferation of internet technologies and Web 2.0 in particular has facilitated activities that people are spending long hours in creating and sharing content online. These include video clips generated and shared on YouTube, images on Flicker, and a proliferation of blogs and wikis. In his book 'Cognitive surplus: Creativity and generosity in a connected age', Shirky (2010) showed that tapping into the cognitive surplus has brought important opportunities for other internet users. A typical example of tapping into the cognitive surplus is the freely available open content wiki, Wikipedia, where wikipedians are generating knowledge collaboratively and cooperatively to be used by all Wikipedia users.

Similar cognitive surplus is taking place in higher educational institutions, particularly in the area of student-generated content. This type of cognitive surplus of projects, portfolios, assignments and other knowledge production activities are available in most universities, however, there are some attempts at tapping into it or repurpose student-generated content through pedagogically informed approaches (Bates & Galloway, 2013; Denny, Luxton-Reilly, & Hamer, 2008; Gehringer, 2011). Additionally, limited research exists on repurposing student-generated content in the OER development process. Importantly, handling students the responsibility of generating learning resources that can be reused by other learners can help enhance self-esteem through achievement and ownership of their work that can be shared through OER.

During the researcher's academic experience at Arab Open University, she witnessed many cases where students created learning resources for each other, collaboratively and autonomously. Most importantly, those who created the learning resources were also learning at the same time. For example, in the 'Database Management System' course (CS490), students created and shared 'database normalisation examples', a design technique used as a guide in designing relation databases through discussion forums of the learning management system (Moodle). Students also created for themselves an informal virtual space where they learnt from each other and shared learning resources in different formats (see www.aoua.com). The candidate ventured into this journey from 2008 to 2010 as a tutor and a unit coordinator in the Faculty of Computer Studies. However, the generosity of students creating and sharing their own intellectual property has never been tapped into and remains uncategorised and disconnected from the pedagogical approaches and formal learning process.

Similarly, the same phenomena appeared to be replicated in the SCEM at WSU where students enrolled in different study units created projects as part of their unit assessment with or without the use of ICT. For example, the 'Introduction to IT' unit (300134), offered from the SCEM to university students, usually has a high rate of enrolments, averaging 150 students per semester. As a part of the unit assessment, students are required to develop projects to show their capabilities of using different content authoring software tools. At the end of the semester, a considerable number of projects is evaluated and marks and feedback are conveyed to the students. However, the value derived out of these projects has not been realised by the teaching team, as these projects have never been reused, put on showcase or tapped into. In similar cases, students enrolled in the 'Foundations of Statistical Modelling and Decision Making' unit (200036) and 'Data Mining and Visualisation' unit (300606) created summaries of the unit topics in the form of portfolios. Their tasks usually included providing complete explanations of particular modules with their own created examples. At the end of each semester, these portfolios are archived by the unit coordinator, and according to university policies, archives become obsolete after five years.

In this context of computer science and information technology education, the project-based learning approach generates an abundance of knowledge that students created during academic semesters. However, these projects have rarely been tapped into, even with innovative projects that can create a showcase of the teaching experience, as well as demonstrate graduate attributes to the community. Further, creativity can also be found among these projects and utilising them could create new opportunities for other learners. Therefore, there is a need to develop a new learning approach that taps into student-generated content as part of the learning assessment of study units.

Hence, the proposed OER development model provides the solution to tap into the cognitive surplus of student-generated content through engaging students in the OER development process. Importantly, the solution is based on practical evidence from integrating the model into three study units in the undergraduate learning environment, and theoretically documenting the design principles at the end of this thesis. The design principles can be reused by other higher educational institutions to adopt OER projects in similar contexts.

1.3 Responding to the problem

OER projects have started to contribute to advance knowledge for all types of learners, and to receive attention and consideration in formal and informal learning environments. However, these projects require careful considerations, especially when practised in higher educational institutions where the quality of learning resources and improving learning performance are critical. These dimensions intersect with challenges of the OER development worldwide, as OER initiatives support the stance that education is open and free for all, although does not indicate cheap quality learning. Additionally, with the rapid increase in the number of learners around the world, OER are providing opportunities and opening up learning paths for different types of learners, especially those who cannot afford it (D’Antoni & Savage, 2009). Therefore, a new OER development model needs to be carefully designed based on a solid theoretical framework in order to: (i) achieve sustainability as a general aim; (ii) enhance the quality of the learning resources; and (iii) improve learning performance.

Maintaining sustainability is a challenge for the OER development process, however, the resources that maintain this feature should also be sustainable and continuously running. Thus, funding solutions have not always proved successful as many OER projects failed to sustain for other reasons. This challenge of sustaining resources raised the need to find other resources and investigate their potential sustainability to identify whether they can be utilised to support the OER development process. This can be done by showing how these solutions work in a real life setting, and by providing evidences and recommendations about the solutions. Under this general aim of sustainability, the new OER development model proposed in this thesis aims at tapping into student-generated content as sustainable resources for OER development process, as this area has an abundance of intellectual efforts that are generated at every academic semester, however, have rarely been utilised effectively. The model also aims at improving the quality of generated learning resources during the development process, and engaging undergraduate students in their learning experience as they generate learning resources based on what they have learnt.

The proposed OER development model in this thesis also anticipates setting up communities of practice (Wenger, 2006) around OER. The term is defined as ‘groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly’ (Wenger, 2011, p.1). The concept ‘communities of practice’ requires three essential elements, namely: (i) domain; (ii) community; and (iii) practice. In the OER development model, these elements can be described as following:

1. **Domain:** Groups of students and their teachers in a particular study unit share the same interest of developing learning resources that can be published via OER. The learning resources are generated in collaboration between students and their teachers, and through OEP. The value of this collaboration appears through tapping into student-generated content while teachers facilitate building the learning resources through using their own teaching experience and transferring it to their students.

2. **Community:** Students and teachers engage in building, evaluating and publishing the learning resources as they become involved in discussing, sharing knowledge and learning process activities.

3. **Practice:** The OEP is the theme that runs along the activities. The development process of the learning resources includes a set of activities that prompts openness in the learning process. It is anticipated that the OER development model will be

sustainable as new students reuse and improve the learning resources of previous academic semesters.

Therefore, by engaging university students in the OER development process through collaboration with their teachers and with publications via OER, there is a potential to establish communities of practice and sustain the OER development process in such communities. However, to understand how these communities can grow, the model has been designed in real life educational settings and evaluated with collaboration between researcher, teachers and students.

Finally, engaging users' community in the OER development process is not a new development model, as few OER models have engaged students in the OER development process or reflected on the benefits that students can obtain from being a part of the learning process (Neary, 2010; Winn & Lockwood, 2013). However, to date, little research investigated the quality of student-generated learning resources that can be generated and shared as OER.

1.4 The research aim

The aim of this research is to address the challenges of the OER in higher education by developing and evaluating a sustainable OER development model that taps into the cognitive surplus of student-generated content through establishing communities of practice of students and teachers around the OER development process.

1.5 Research questions

Three primary research questions were designed to investigate the research problem by focusing on three aspects. Primary research question 1 and its three sub-questions investigate the *process* of potential sustainability of the proposed OER development model. Primary research question 2 and its three sub-questions investigate the quality of the *outcome* of the proposed OER development model. Primary research question 3 and its three sub-questions investigate the *learning design* of the OER development model.

Primary Question 1

Does involving students in generating learning resources provide a sustainable mechanism for developing quality OER?

Primary Question 1 sub-questions

1. Does previous experience with content authoring software tools affect the quality of student-generated learning resources? If so, what types of content authoring software tools provide better quality student-generated learning resources?

2. Does previous experience with user-generated content affect the quality of student-generated learning resources? If so, what types of user-generated content do university students create in their daily life for non-educational purposes?

3. What are the incentives that motivate students to participate in generating learning resources for OER?

Primary Question 2

Does involving students in generating learning resources help improve their learning performance?

Primary Question 2 sub-questions

1. How does involving student in generating learning resources engage them in their learning experiences?

2. How does involving student in generating learning resources help improve their academic achievements?

3. In what way does involving student in generating learning resources help improve the educational practice?

Primary Question 3

How can the proposed OER development model be designed so that it provides continuous OER service for higher educational institutions and supports students to play an active part in their learning experience? What are the design principles?

Primary Question 3 sub-questions

1. What are the technical scaffoldings that are required to support students in the development process of OER?

2. What is the role of the teacher in the development process?

3. What are the learning activities that support the development process?

1.6 Research objectives

This thesis focuses on developing and evaluating a new OER development model and producing the final design principles that help to integrate the model in the learning environment. Objectives of this body of work are:

1. To contribute to the literature of OER development process in the area of higher education, and to identify new areas where OER can be utilised in formal learning.

2. To provide evidence of the efficacy of the OER development model in educational setting by: (i) evaluating the learning experience of engaging undergraduate students in generating OER; and (ii) assessing the quality of the learning resources.

3. To establish communities of practice of students as content developers, teachers and co-creators around OER in higher educational institutions that evolve throughout academic semesters.

4. To generate reusable design principles of OER development model that can be used by higher educational institutions.

1.7 Thesis structure

The thesis is structured around eight chapters and nine appendices that align with the DBR as the adopted methodology, and its iterative nature of conducting the research through iterations. This alignment can be observed with the growing literature review over the chapters (Chapters Two to Seven) and the development of the solution over three iterations (Chapters Five to Seven). The chapters are organised as follows.

Chapter One: Introduction introduces the area of OER and highlights the challenges faced in higher education on the adoption of OER. The chapter states how these challenges were addressed in the thesis, gives a specific aim of the research and lists the research questions and objectives of the research study.

Chapter Two: Literature review presents a review of relevant literature in the area of OER, including six elements within an OER project. The chapter extends on two themes that emerged from investigating the OER literature: (i) value of openness in higher education;

and (ii) concept of the cognitive surplus. Both concepts contribute to the initial theoretical framework for the proposed OER development model. The chapter then investigates sustainability of OER in higher educational institutions, focusing on the engagement of students in generating OER. The chapter ends with highlighting the benefits of OER in higher education and the value of adopting OER projects.

Chapter Three: Investigation of OER challenges identifies the challenges of OER in higher education and presents the argument of the importance of three main challenges: (i) raising awareness of the value of OER in higher education; (ii) a lack of academic participation in generating OER; and (iii) concerns of quality of OER.

Chapter Four: DBR methodology as a response to OER development challenges justifies and describes DBR as the methodology adopted in the study. The chapter shows how DBR helped to develop and evaluate the design principles of the OER development model in the learning environment. An overview of the process of adopting DBR in the following three chapters is presented. The chapter then highlights the four phases of the methodology.

Chapter Five: Starting stage of the OER development model – Iteration 0 presents Iteration 0 of the OER development model in one undergraduate study unit (Cycle 1) in the SCEM for the academic semester Spring 2012. The chapter aligns with the DBR methodology and reports on the four phases on Iteration 0. Phase One extends on the literature review presented in Chapter Two and focuses on the role of openness and technologies supporting education, the existing OER development model, student-generated content and the cognitive surplus to generate the initial design principles. Phase Two presents the initial design principles. Phase Three shows the implementation of the model in real-life educational settings (Cycle 1) and describes the cycle, participants and data collection. Data analysis and discussion of the initial implementation of the OER development model are also included in Phase Three. Chapter Five concludes with Phase Four highlighting the feasibility of the model for the following iteration and provides recommendations on the design principles.

Chapter Six: Growing stage of the OER development model – Iteration 1 builds on Chapter Five (i.e. previous iteration) and presents Iteration 1 of integrating the refined OER development model in the same study unit (Cycle 2) for the academic semester Autumn 2013. The structure of Chapter Six is also compatible with the DBR methodology. The chapter provides further explorations of the literature by investigating the area of digital natives, which identifies the participants (students at the undergraduate study level) of the research in Phase One. Phase Two updates the design principles based on the literature review of Phase One. Phase Three presents Cycle 2 which repeats the integration of the modified OER development model in the same study unit of previous chapter (Cycle 1) and presents data collection and analysis, as well as provides further recommendation on the evaluation of the OER development model and the role of teachers in the learning environment for the last iteration of the research.

Chapter Seven: Adapting stage of the OER development model – Iteration 2 presents the final iteration of the research through integrating the OER development model in three undergraduate study units of the same school in the academic semester Spring 2013. Cycle 3 is the same unit of Cycles 1 and 2, where Cycles 4 and 5 are new units at an advanced level at SCEM. The chapter also aligns the DBR and reports on the four phases. Phase One responds to the previous recommendations of Iteration 1 and extends on the literature review of learning theory, learning resources evaluation and diffusing innovation theory. Phase Two modifies the design principles based on the literature review. Phase Three presents the integration of the modified design of the OER development model in three study units by emphasising the role of the teacher in the learning environment, and identifying the technical and learning scaffolding required. Data collection and data analysis are also included in Phase Three. Phase Four provides final modifications to the design principles of the OER development model.

Chapter Eight: Design principles of the OER development model presents the research questions and elaborates on the response to each question. The chapter also provides a reusable list of design principles of the OER development model and recommends reusing the model in higher educational institutions.

1.8 Summary

Chapter One provides guidelines for the entire thesis, highlights its main components of the documented research, discusses the challenges of OER in higher education as the focus of the research investigation, and brings awareness for a need to address these challenges for the future of higher education.

Chapters Two, Three and Four present in-depth investigation of the literature review of OER in higher education and its challenges.

Chapter Two: Open educational resources in higher education

2.1 Introduction

Chapter One has set the research framework of the thesis by highlighting the context of the study, open educational resources (OER) in higher education, the research problem, research objectives and questions that are investigated. In Chapter Two, an exploration of the theoretical framework that recommended the initial design solution of the new OER development model is provided. The literature review started with a comprehensive review of the concept of OER and their existing projects. Two other concepts emerged from OER literature and used as cornerstones of the theoretical framework of this thesis: (i) openness; and (ii) cognitive surplus. Thereafter, the literature review explored the role of OER contributors in higher education, the challenge of sustainability of OER in higher education, and the role of students in generating OER. Chapter Two also presents the benefits of OER for higher education that have motivated the research work in this thesis.

2.2 Concepts of open educational resources and open educational practice

This section elaborates on the concept of OER, as well as emphasises that openness and knowledge-sharing, licensing and legal use, reuse of learning resources, and open educational practices (OEP) are factors that maintain sustainability of OER development. Section 2.2 also describes the role of OER in the context of higher education and identifies six elements for an OER development project.

Since 2002 when the concept of OER was first presented at a UNESCO forum, there has been a growing interest in OER. The UNESCO Forum on the Impact of Open Courseware for Higher Education in Developing Countries viewed OER as ‘the open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes’ (UNESCO, 2002). This forum established significant interest in OER for different stakeholders after which there become increased momentum in using OER by learners and educators throughout the world in formal, informal and non-formal learning.

Since its inception in 2002, OER has been anticipated as the movement that contributes to the United Nations making education a right for everyone and aligns with Article 26 of the Universal Declaration of Human Rights that states: ‘Technical and professional education shall be made generally available’ (United Nations, 1948).

The first open learning content was announced in 1998 when David Wiley coined the term ‘open content’ and launched his project, working on the premise that educational content should be developed and shared freely and openly as in a free software philosophy (DiBiase, 2011). Free software originated in 1983 when Richard Stallman announced the establishment of the GNU project (Caswell, Henson, Jensen, & Wiley, 2008). The concept of open content also embraces the definition of learning objects. Hodgins first described learning objects as:

> *… fundamental elements of a new conceptual model for content creation and distribution. They are destined to change the shape and form of learning, ushering in unprecedented efficiency of content design, development, and delivery. Their most significant promise is to increase and improve the effectiveness of learning and human performance.* (Hodgins, 2002)

In OER research studies, researchers refer to OER as ‘learning objects’ (Hylén, 2007) while others tend to provide theoretical definition for each term (EDUCAUSE Learning Initiative, 2010; Friesen, 2009; Geser, 2007; Wiley, 2012). The OECD limits OER to digitised materials that are offered freely and openly for educators, students and self-learners to use and re-use for teaching (OECD, 2007a) whereas the OER foundation emphasis that OER are

> *… the educational material that are licensed to provide permissions for individuals and institutions to reuse, adapt and modify the materials for their own use. OER include full courses, textbooks, streaming videos, exams, software, and any other materials or techniques supporting learning.* (OER Foundation, 2012)

Open content embraces the definition of learning objects as open content development allows the reuse of existing content and permit others to reuse it freely. The availability and distribution of open content through OER gives learners and teachers more opportunities to adapt open content in the learning process without the need to develop new resources or duplicate ones that already exist. In addition, the effective way to design open content is to license the work while maintaining the intellectual property of the reused resources and utilising open content in design, development and delivery. Therefore, the promise to improve the effectiveness of learning and human performance is embraced by advocates of

OER since its inception in 2002, which continues to evolve and provide opportunities for learners around the world. A comprehensive report prepared for the William and Flora Hewlett Foundation in 2011 defined OER as:

> *Open Educational Resources (OER) are digitized educational resources that are freely available for use by educators and learners, without an accompanying need to pay royalties or license fees. The digitized resources may be shared via the internet or using media such as disk drives. OER are usually, but not exclusively, licensed using Creative Commons licences. Both the original owners of the material and the subsequent users need to clearly understand the terms of these contracts to appreciate the ways in which materials may be remixed and shared.* (West & Victor, 2011, p. 9)

West and Victor's (2011) definition emphasises how OER can be reused by subsequent users legally without infringing the intellectual property of the original authors. This clarification of OER's terms of use has helped in the proliferation of the use of OER among academics and learning content developers. The use of open licences has also helped with developing learning material available from different OER. As a result, the learning content increases through reusability as learning resources are being improved by other users and widely used among all types of learners (Caswell et al., 2008; Geser, 2007).

The first large scale OER initiative in higher education was launched by the Massachusetts Institute of Technology (MIT) in 2002 called the MIT OpenCourseWare (MIT-OCW). The initiative greatly encouraged the emergence of OER communities around the world (Hodgkinson-Williams & Donnelly, 2010). As of September 2014, over 2150 courses were available through MIT-OCW.

The Open Education Consortium, known previously as Open Courseware Consortium, is an organisation with over 200 higher educational institutions members. The consortium was incorporated in 2008 under the laws of the Commonwealth of Massachusetts in the United States of America (Open Education Consortium, 2015). It supports the open courseware, OEP and OER through its online portal by building a culture of openness in higher education systems and provides the opportunity for people around the world to use and learn from the shared body of knowledge and best practices of a global network of experienced educators.

However, without understanding and support of OEP in higher education, institutions will not be able to adopt OER development in its learning and teaching approaches. The Open

Educational Quality Initiative (OPAL) defines OEP as “practices which support the (re)use and production of OER through institutional policies, promote innovative pedagogical models, and respect and empower learners as co-producers on their lifelong learning path” (OPAL, 2011, p. 12).

The Cape Town Open Education Declaration agrees and extends on the OEP definition by stating that: 'open education is not limited to just open educational resources. It also draws upon open technologies that facilitate collaborative, flexible learning and the open sharing of teaching practices that empower educators to benefit from the best ideas of their colleagues. It may also grow to include new approaches to assessment, accreditation and collaborative learning'. (The Cape Town Open Education Declaration, 2008).

The two definitions of OEP encompasses OER development, adopting open pedagogies in teaching, open learning, open access, open sharing of teaching approaches and use of open technologies.

Even though that OER development comes under the wide definition of OEP, understanding OEP can be crucial to the optimisation of OER development. As the OER development process in its essence requires the adoption of open access to already existing learning resources to avoid reinventing the wheel, open sharing of learning content through open educational resources repositories and the use of available open technologies such as Web 2.0 tools in content development.

2.3 Elements and themes of open education resource projects

The history, definitions and initiatives of OER in previous sections share six elements that comprise of OER projects and incorporate two themes. The elements have been highlighted separately in different OER reports and existing policies, however, the following list provides a concise summary of six elements that are essential for any OER project:

1. **Learning Material** includes any digital learning material that can be used for educational purposes and published in a different format. For example a complete course, open textbooks, quizzes, assessments, videos of lectures, assignments, lecture notes, interactive tutorials, lesson plans and educational software tools. These learning resource formats have been highlighted in the OER report that has been provided for the William and Flora Hewlett Foundation by Atkins et al. (2007) for the OER

movement since its inception. Additionally, this element was highlighted in a white paper presented by Pawlowski and Hoel (2012).

2. **Information and Communication Technologies (ICT)** includes ICT that support the development and publishing of OER, such as free and open source software (FOSS) and content authoring software tools, content management systems and content repositories (D'Antoni & Savage, 2009,; Geser, 2007).

3. **Stakeholders** include end-users of OER, such as content developers, learners, educators and researchers (West & Victor, 2011).

4. **Institutions** include universities (e.g. Massachusetts Institute of Technology, Open University-UK) and non-profit organisations (e.g. Creative Commons, Open Education Consortium) that play a significant role in supporting OER initiatives globally. This element also includes governmental bodies (e.g. Higher Education Funding Council for England (HEFCE)) and communities (e.g. OpenStax project, previously known as Connexions Project) (West & Victor, 2011).

5. **Learning design** comprise of the methods, tools and approaches used to develop pedagogically informed learning resources when using existing technologies (Conole et al., 2010). Learning design is an important element that maintains the educational and technical quality of OER as it facilitates content transfer and reusability (Lane & McAndrew, 2010). Learning design is the most important aspect that teachers need to consider when adopting innovative pedagogical approaches (Conole, 2013, p.117). By making the learning design more explicit Conole (2013) argued that "a teacher is better able to get an overview of the whole design and hence be able to see how the different elements of the design are connected and also to identify potential gaps or weaknesses in the design" (p.133).

6. **Intellectual property** is the legal use and reuse of OER associated with open licences for online distribution (e.g. Creative Commons licence) (William and Flora Hewlett Foundation, 2013). Sharing and reusing of learning resources has been always a common practice in academia, however the wide proliferation of online learning resource from around the world encourage these practice to become more visible. Consequently, a need has arisen for creators of learning resources to understand how to communicate the terms by which they are sharing their work (Groom, 2013).

However, as presented earlier in section 3.2, that among the main challenges of using existing OER is a lack of understanding of how to reference open learning resources. Creative Commons had set out to simplify the process of licensing educational resources. Creative Commons' first project, in December 2002, was the release of a set of copyright licences for public use (see http://creativecommons.org/). These machine-readable licenses are designed for websites, scholarship, music, film, photography, literature, courseware, etc and they help people make their creative work available to the public, retain their copyright while licensing them as free for certain uses, on certain conditions. ccLearn, the educational division of Creative Commons, was launched in 2007 and is dedicated to realizing the full potential of the internet to support open learning. It is expected to further reduce barriers to sharing, remixing and reusing educational resources (Yuan et al, 2008). Importantly, sharing learning resources using open licenses can have significant effect on the facilitating the process of reuse or repurposing of the learning content. Therefore, understanding intellectual property rights are now recognised as an important part of digital literacy.

Figure 2.1: Six elements of Open Educational Resources projects

The six elements of Figure 2.1 were found to be essential for any OER project, and need to be considered in proposing a new OER development model. In addition to the six elements, two concepts have emerged from the literature review of OER – openness and cognitive surplus. The following subsections highlight the two definitions, in addition to Chapters Five and Six providing in-depth analysis of the two concepts and their role to inform the theoretical framework of the OER development model proposed in this thesis.

2.3.1 Concept of openness

Peters (2010) defines openness as:

> *A concept that has come to characterize knowledge and communication systems, epistemologies, society and politics, institutions or organisations, and individual personalities. Openness in all these dimensions refers to a kind of transparency which is the opposite of secrecy and most often this transparency is seen in terms of access to information especially within organisations, institutions or societies.* (Peters, 2010)

The definition of 'openness' stresses transparency in different dimensions of life, which led other concepts to emerge, such as open government, open-source software and open learning. The variations of openness value the unrestricted access to information, collaborative work, cooperative management and decision-making rather than an act of centralisation. Openness has also been considered the dominant affective force of the internet (Gascó-Hernández, 2014). This association of the term 'openness' to the World Wide Web translates to the nature of the internet as being accessible by anyone in the world. This accessibility also means that anyone can use, reuse and be part of this worldwide network, the matter that helped in creating opportunities with public values to the sum of whole human societies (Shirky, 2010).

The governmental sector adapts the idea of freedom of information through the concept of open government, which means that the public has enforceable rights to access records and information held by government or public bodies (Peters, 2010). This openness is represented by the principles of transparency, allowing public participation and collaboration by the wider community members (Linders & Wilson, 2011). In computing and information technology (IT), the association of openness in new technologies is reflected in the open-source software (e.g. Apache servers) and open hardware architecture (e.g. IBM compatible personal computers) that are playing significant roles in advancing the ICT revolution (Singh & Gurumurthy, 2013).

The educational sector is not an exception; openness is gaining greater attention in formal learning. According to the Horizon Report 2013, openness has been identified as the 'number one trend to affect learning, teaching and creative inquiry in higher education, and a key driver for educational technology adoption for the period (2013-2018)' (Johnson, Adams, Cummins, Estrada, Freeman, & Ludgate, 2013, p. 7). For example, open learning, OER, OEP, open textbooks, open research and the recent innovation of Massive Open Online Courses (MOOC) are variations of implementing the term 'openness' in formal education.

In this thesis, openness through OER projects is anticipated as a significant path that can enhance the quality of learning outcomes of TELE in higher educational institutions. Since 2002, the OER movement established a record of knowledge advancement and achievements in formal and informal learning environments. The implementation of the concept of openness proved that knowledge-sharing can lead to improvement in knowledge quality and services. Further, the reusability of learning resources in different format (Wiley, 2007) and the use of open licensing have contributed significantly to improving knowledge through OER initiatives (D'Antoni & Savage, 2009).

Therefore, adopting openness and OEP are keys to the OER development process that need to be considered in the principles of OER development models.

2.3.2 Concept of cognitive surplus

A relatively new concept cognitive surplus has been coined by Shirky (2010), which he used to describe the creativity and generosity that online communities create as a result of collective intelligence and collaboration with the driving force of motives. Shirky has provided many examples of the cognitive surplus in our lives that reflect the concept, however, the value of each example differs from personal, communal, public or civic value. Based on Shirky's examples, the cognitive surplus can be defined as an abundance of online contributions that people do collaboratively when using social networking software tools and as a result of crowd-sourced activities with the driving force of intrinsic or extrinsic motives. Shirky (2010) argued that by tapping into the cognitive surplus, people create value for themselves and the community.

The introduction of social media and Web 2.0 tools has changed the way people access information. What was scarce previously is now in abundance (Shirky, 2010). This abundance of information is described as ‘cognitive surplus’. Learning resources previously found in libraries were sometimes hard to obtain, for example, it may be required to travel considerable distance to get hold of a particular book. However, in the last few decades, the introduction telecommunication technologies has resulted in a dramatic acceleration in knowledge production and led to the emergence of ‘information society’ (Kozinska, Kursun, Wilson, McAndrew, Scanlon, & Jones, 2010).

The cognitive surplus also describes OER from economic and social perspectives. The OER projects provide valuable opportunities within different areas of knowledge for all learners to use and reuse. These learning resources are usually developed by educators and community contributors who have experience in learning and teaching in their subject area. The generosity of sharing learning resources openly is the essence of OER initiatives and the willingness to do so with intrinsic motives are the driving force of creating and sharing OER. The OECD (2007a) conducted case studies at institutions with OER projects and looked into the reasons for engaging them in OER. Yuan, MacNeill and Kraan (2008) concluded that motives of institutions to create and share OER are both intrinsic and extrinsic.

Most existing OER are initiated within higher educational institutions boundaries that provide the appropriate culture for creating and sharing OER. Individual academics from different areas of study contribute towards building learning resources and sharing them freely through OER. This generosity of knowledge-sharing, along with the opportunities they provide for anyone to access, use and reuse openly, is what Shirky (2010) described as ‘public value’ where academics openly create contributions for other academics and learners to use, reuse, generate and share. Therefore, in order to maintain the sustainability of a new OER development model or OER initiative, it is important for stakeholders to consider higher educational institutions as rich opportunities to work with, and consider tapping into the cognitive surplus inside the educational boundaries.

2.4 Contributors of open educational resources in higher education

The majority of pioneering OER initiatives originated within organisational boundaries such as higher educational institutions, libraries, consortia and communities. These initiatives have also been supported by non-government organisations (NGO) and private organisations, or by the founders themselves. At the forefront are colleges and universities, such as MIT-OCW of Massachusetts Institute of Technology and OpenLearn of the Open University of UK that established their Open Courseware initiatives for more than a decade, in addition to the recent initiative of Open Education Resource University (OERu) that consisted of a virtual collaboration of like-minded institutions committed to creating flexible pathways for OER learners to gain formal academic credit, as well as aimed at making university level study more accessible, affordable and efficient for all learners around the world (Taylor & Mackintosh, 2011). Libraries have also been involved, such as the Harvard Open Collections Program, Peer-Reviewed Instructional Materials Online – PRIMO, Animated Tutorial Sharing Project – ANTS (Pryde, 2009) and a recent initiative by North Seattle Community College that aggregated OER and allowed searching OER by subject and format (Libguides.northseattle.edu, 2014). The international consortia led the way for existing initiatives around the world to find a portal that aggregates learning resources developed from its members, such as in Open Education Consortium, Teacher Education in Sub-Saharan Africa and national initiatives, such as Repository.ac.nz, New Zealand OER project and the Thutong portal. In addition, other OER have been developed by communities, such as in the OpenStax project, which is one of the leaders in open collaboration that accepts contributions from any place in the world. There are also initiatives led by individuals, such as in Free-Ed and the OpenFiction Project (OERWIKI, 2011).

Most OER contributors are academic staff members. When OER are being developed in an open environment, educators collectively improve the educational content they see as most valuable, and introduce new alternatives for effective teaching, as is the case with the OpenLearn initiative of Open University – UK (McAndrew, 2010). However, it is recommended that educational institutions have strategic plans in place for their policies, practices and institutional culture rewards, as well as collaborative work of academics in developing OER through encouraging individuals on the use and reuse of existing OER (South African Institute for Distance Education - OER Africa, 2011). Furthermore, OER have the potential to expose learners to the extensive content that limits educational resources and reduces the costs of educational material for learners (EDUCAUSE Learning Initiative, 2010).

A report published in 2007 by the Open e-Learning Content Observatory Services (Geser, 2007) explained how OER can play an important role in teaching and learning, and helping people acquire the competencies, knowledge and skills needed to participate successfully in the political, economic, social and cultural realms of society. The report highlights the need to promote innovation and change in educational practices through adapting the OEP so that OER can play a major part in improving the educational system.

Therefore, higher educational institutions can open up great opportunities for further OER projects to be initiated. These opportunities have important potential due to the diverse communities of academics in higher educational institutions and the wide range of collaborations that can happen between faculties, departments and students in the OER development process. Establishing communities of practice around OER in higher educational institutions can create potential to showcase the quality of learning that is taking place in the institutions, and open up the opportunity to become a sustainable part of the global knowledge development network. Further, these communities can lead to a better engagement of teachers and learners in the learning process. The following section supports the significance of OER and their benefits for institutions, teachers and learners.

2.5 Sustainability of open educational resources in higher educational institutions

Many OER projects have been initiated in higher educational institutions in different countries around the world including the United States of America, Spain, United Kingdom, Netherlands, France, South Africa, Saudi Arabia, Japan, China, Australia and New Zealand (Open Education Consortium, 2015). Massachusetts Institute of Technology, Open University of the United Kingdom, Open University of Netherlands, Utah State University, University of Cape Town and Johns Hopkins Bloomberg School of Public Health are among pioneers in OER development projects. These institutions realised the benefits of OER in higher education since its beginning in 2002 and started to share their educational material free of charge. For a long time, higher educational institutions have been repositories of human knowledge (Johansen & Wiley, 2011), therefore, the continuity of OER projects in higher educational institutions is tied to availability of qualified human resources and the process of knowledge production in formal learning. For example, in the area of supporting OER in higher education, the Open Education consortium serves as a resource for starting and sustaining open courseware projects as a coordinating body for OER projects on a global scale and as a forum for the exchange of ideas and future planning (Open Education Consortium, 2015). At the time of writing this thesis, according to its website, the consortium consisted of 18 sustaining members from higher educational institutions and 248 members, including formal and informal bodies from 47 countries.

However, many researchers raised the concern that even OER are playing a key role in teaching and learning in higher education, sustainability of OER projects remains the most significant challenge (Atkins et al., 2007; Bossu et al., 2012; Hodgkinson-Williams, 2010; McAndrew, 2010 ; West & Victor, 2011). The sustainability of OER development projects was defined by Wiley as ‘the ongoing ability of an OER to continue operating and meet its goals’ (Wiley, 2007, p. 5). He emphasised that funding is not the only factor that maintains OER project sustainability, and that stakeholders are required to understand OER project’s goals and specific activities that must be carried out to meet those goals and create sufficient motivation for engagement in those activities in order for OER projects to continue operating (Wiley, 2007).

In Europe, the HEFCE invested in the area of OER through the Joint Information Systems Committee (JISC) UK and the Higher Education Academy through a three-phase program between 2009 and 2012. The program aimed at promoting the adoption of OER in UK higher education, stating:

> *Sustainability in relation to OER is closely linked to the business model or approach that an individual, group or institution adopts to release, manage and support OER. It is not just about sustaining existing OER but about* ***embedding processes*** *and* ***transforming practices*** *to support ongoing OER production and release.* (McGill, 2013)

The above definition of sustainability emphasises that in order for an OER project to continue operating, stakeholders need to establish motives for participation and work to harness OEP. Additionally, they need to extend the participation of OER projects in higher education through engaging students in the OER development process, which is an area that can provide a promising path to addressing the challenges of OER sustainability. The OER Synthesis and Evaluation Project indicates that adopting OER at the institutional or community level can have a significant impact on the sustainability of OER development process (OER Synthesis and Evaluation Project, 2010). Higher educational institutions are diverse environments of learning and knowledge production activities, and repurposing part of these activities towards generating OER is one approach to sustaining OER projects. Hence, OER projects can be sustained in higher educational institutions through intrinsically motivated human resources who are willing to share their intellectual property, adopt OEP in learning and teaching processes by raising awareness and expand participation in generating OER to engage students in these communities around OER development

On the other hand, a body of literature exists on approaches for sustaining OER in higher educational institutions. Hodgkinson-Williams and Donnelly (2010) provided an analysis of OER sustainability models based on the seminal work of Wiley (2007) and Downes (2007). The described models focus on one of three areas in their essence: (i) technical; (ii) funding and management; and (iii) social models. The following list discusses these models and provides examples from existing OER projects.

1. Technical models

i) *Qualified staff:* In most OER projects staff are the main contributors to knowledge development of OER. For example, MIT employs 29 members in its OpenCourseWare project MIT-OCW, including eight core staff, five publication managers, four production team members, two intellectual property researchers and 10 department liaisons (Wiley, 2008). Another example is OpenLearn which gives free access to online university level material from Open University UK which has been a leader in distance learning since 1969. Staff from Open University were responsible for establishing the OpenLearn project (McAndrew et al., 2009).

ii) *Integration with existing systems:* Integration with existing learning management systems to enable the wide proliferation of the OER is a key factor, as it helps to ensure visibility and discoverability of OER (Hodgkinson-Williams & Donnelly, 2010). For example,Vassileva (2009) illustrated an approach for designing social learning environment for OER by using existing technologies such as ontology, exploratory search, collaboration, trust and reputation mechanisms, mechanism design and social visualisation.

iii) *Enforcing standards for reuse:* Many standards have been developed to assist with the reusability of learning contents, such as SCORM (Sharable Content Object Reference Model), IMS learning design specifications and Dublin Core metadata being the most commonly used. New software tools are capable of automatically reshaping open learning resources on the internet in order to improve searchability, interoperability and reusability. For example, OCWise (Freschi, 2008) helps academics and content developers to easily embed learning standards within the generated learning content.

2. Funding and management models

i) *Funding models*

- The membership model allows for annual or seed funding by interested organisation(s) to sustain the operating of OER services. Adopters of this model include the Open Education Consortium and the OpenStax project.

- The donation or voluntary support model is where an OER project receives support from a community of users, for example, MIT-OCW receives support from the MIT alumni. Similarly, Wikipedia receives donations from a wide community of users. For example, in December 2010, the State Library of Queensland, Australia, donated a hard-disk of 50,000 public-domain images to Wikimedia Australia to be used in Wikipedia pages.

- The conversion model is where a resource is published for free to attract users who will be converted to paying customers. For example, the OpenStax project receives approximately 15% of the cost of books being printed from the site.

- The contributor pay model is designed to charge a publication fee to the authors, institutions or funders for each article published, as contributors and authors pay the publisher for maintaining their research articles and educational resources. The publisher eventually makes the work freely available online. This model is adopted by the Public Library of Science (Public Library of Science, 2015).

- The institutional model is where the institution announces its responsibility for funding the OER project. For example, MIT-OCW receives its funding from the budget of MIT, which covers around half the annual cost of the project. The OpenLearn initiative of Open University UK is also supported financially by the institution.

- The governmental model offers direct funding, for example, OpenLearn was granted a further £3 million for 2009-2012 from HEFCE.

ii) M*anagement models or centralised management of OERs projects* is where institutions undertake the bulk of the work. MIT-OCW is highly centralised and tightly coordinated in term of organising and providing services. The project is fully dependent on paid employees. On the other hand, the USU-OCW model is a hybrid model where OER project work is split between university staff and volunteers.

3. Social models

i) *Community model*

A common approach to building OER is the community model (Hylén, 2006; Koohang & Harman, 2007) where individuals contribute their time and effort on a voluntary basis. Unlike the institutional model, the production and distribution of resources are decentralised. For example, this model focuses on who creates the resources, how they are distributed and how others can use them. The main considerations of this model are discoverability of resources, constrained openness, licensing issues, staffing, incentives, workflow and co-production, and finally maintaining and updating resources (Hylén, 2006). An example of the community model is the OpenStax project managed in a decentralised fashion by university professors who volunteer and provide almost all of the services (OpenStax, 2015; Wiley, 2007).

ii) *Translations model*

In order to make higher education material available to a wider range of learners, a number of projects have included translation to different languages, such as Universia OCW, which provide translations in Spanish and Portuguese for MIT-OCW courses. China Open Resources for Education also provide a framework for Chinese-speaking universities to participate in shared courseware with MIT and other leading universities (Wiley, 2007). Another initiative is by the Turkish Academy of Science to translate 16 MIT-OCW courses. However, the majority of OER initiatives that adopted the translation model use MIT-OCW courses and provide them in different languages but with the same context. However, research showed that culture has an impact on learning and how people learn that can differ for developed countries and developing countries (Hall, 2009). Therefore, the translation model of OER development needs to consider cultural differences and tailor learning resources to meet learner preferences. This is an area that requires further research, however, it is out of the scope of this thesis.

iii) *Collaborative model*

The collaborative model is based on scientific and distributed collaboration between academics in higher educational institutions where academics in similar field work together in cross-institutional settings to generate OER. The model is harnessed with the advent of Web 2.0 technologies that facilitate such collaborations (Luo, Ng'ambi, & Hanss, 2010).

The models also share OEP, legal distribution of OER and utilisation of ICT to facilitate the OER development process. For example, developing an environment for open access is one of the core aspects of OER that requires, for example, adopting OEP of use and reuse of OER, using intellectual property licensing for online publishing, such as Creative Commons licences, and utilising ICT that becomes essential for contemporary learning interventions.

Concern about sustainability of existing OER funding models was raised, especially when funding resources dried out (Koohang & Harman, 2007). Therefore, finding alternative solutions need to focus on harnessing intrinsic motives to encourage participation in the OER development process, which can have a better effect when comparing extrinsic motives in the cognitive production.

Additionally, among the investigated OER development models in the literature review, few initiatives have engaged students in the OER development process as part of their learning experience. The Utah State University-Open CourseWare (UTU-OCW) model engaged volunteer students working in digital media or instructional design studio classes to assist in the development of learning content. Faculties worked as facilitators of the production process. It was anticipated that the UTU-OCW project would be replicable by other institutions due to the availability of participating team members and strong relationships between USU-OCW staff and faculty members. The project also received support from the Center for Open and Sustainable Learning, however, it was discontinued due to a lack of funding, resulting in staff terminating the development of new OER in November 2007 (Wiley, 2007).

Student as Producer at the University of Lincoln UK is another project funded by JISC's Open Educational Resources Program UK and the University of Lincoln. The project received a £50,000 grant in 2009 to develop OER to be used in the 'Introductory Chemistry for Forensic Science' course for first-year students at the University of Lincoln UK in the academic year of 2009-2010 (Winn, 2009). The project engaged students and a campus-based enterprise to generate videos for this course as OER, which explained the difficult concepts in chemistry when using a mixture of animation and live action. The project managers argued that the model was sustainable and provided an innovative approach to the development and dissemination of OER (Neary & Winn, 2009).

The engagement of students in developing learning resources for OER in higher educational institutions can be a promising path for sustaining OER. Previous examples of student engagements at Utah State University US and University of Lincoln UK provided real examples of the approach, however, substantial external funding was necessary for the development process and dissemination of OER.

As this thesis reports on a new OER development model that engages students and teachers in generating learning resources, the major resource of sustainability of the model is student-generated content as part of the learning process, typically in a project-based learning approach. By tapping into student-generated content and repurposing their work towards generating learning resources that can be shared as OER, the proposed model works on capitalising on an important resource to sustain OER development process in higher educational institutions.

The literature review of sustainability of OER and OER development models leads to the initial design principles of the new OER development model for higher educational institutions, which include:

- Establishing motives for participation and work to harness OEP are significant factors to maintain sustainability.
- Extending participation of OER projects in higher education through the engagement of students in the OER development process.
- Integrating the OER development model as part of the learning process through a project-based learning approach.

2.6 Engaging students in the open educational resources development process

The focus of this thesis is to respond to the OER sustainability challenge by engaging students in generating and publishing OER. As previously discussed, several OER development projects engaged students in the development process of OER, however, funding was substantial for the sustainability of these projects. The following examples highlight the role of students rather than the source of funding as in the previous section, and elaborate on the learning environment and learning process. In conclusion, lessons learned from each example are used in the initial design principles of the OER development model. The following list extends on these projects, however, the list is non-exhaustive; rather, it provides significant contributions to the body of literature of student engagement in the OER development process and leads to areas that require further research. Projects included:

1. **Student as Producer, United Kingdom:** The Student as Producer (2013-2013) was an initiative by the Centre for Educational Research and Development at the University of Lincoln UK to engage students and staff in constructing knowledge through the use of new technologies (Neary, 2010). The initiative aimed to construct a productive pedagogical approach that depended on re-engineering the relationship between research and teaching, as well as reappraising the relationship between academics and students, where students became engaged in producing knowledge rather than being consumers of it (Winn & Lockwood, 2013). As managers of the Student as Producer project, Neary and Winn (2009) argued that in modern universities there is a disconnect between research and teaching, and the work of academics and students. They suggested that the idea of openness can support overcoming this disjunction. In essence, they suggested that the Student as Producer project approach work on demonstrating how OEP are grounded in the work of universities and academics life in the past, and that the Student as Producer project works towards prompting and developing these practices. By handling students the role of contributors to, and collaborators in, knowledge construction, they were expected to bring technology to the classroom as a norm. Students worked with academics and administrative staff where they learnt from each other on developing curricula and course validation (Winn & Lockwood, 2013).

2. **Utah State University – OpenCourseWare, United States:** The USU-OCW model (2006-2007) engaged volunteer students to work in areas of digital media or

instructional design studio classes and assist in the development of learning content for its OCW. The faculties worked as facilitators of the production process. This model was considered to be more replicable by other institutions due to the availability of participating team members and strong relationships between USU-OCW staff and faculty members in some areas (Wiley, 2007). The USU-OCW discontinued in 2007 due to a lack of funding, however, the model succeeded in attracting groups of volunteer students and recruiting professionals to work collaboratively on developing learning resources. The project managed to develop 50 courses over two-year period.

3. **Student-generated storytelling videos, Australia:** In 2011, Kearney presented a learning design model and pedagogical framework to describe teaching approaches for student-generated storytelling projects. His learning design and associated pedagogical framework were part of an international study that focused on improving the skills of pre-service teachers in generating their own storytelling videos, with the main aim to inform their professional learning in their roles as teacher filmmakers (Kearney, Roberts, & Jones, 2012). The design and framework focused on engaging students in research-based documentation tasks by: (i) helping them with the design and production of their videos, (ii) encouraging them to publish their work through the use of the Web 2.0 tool, (iii) connecting students with peers from other universities to provide a formative assessment; (iv) exchanging ideas about filmmaking; and (v) assessing student learning through summative assessments (Kearney et al., 2012).

   Student-generated storytelling videos provides potential for a pedagogical framework that engages students in generating learning resources. However, this study was conducted within a teacher education context where pre-service teachers created videos under research-based guidelines to help them with their teaching tasks. The context was limited to two boundaries: (i) generating video type resources with large file sizes; (ii) students required to study teaching and learning courses as part of the degree requirements. Additionally, the model by Kearny, et al. (2012) can be replicated in similar environments, however, there is no evidence of using the proposed learning design in different learning environments, for example, undergraduate courses in computing, business and health sciences. In addition, the characteristics of students can differ from those of pre-service teachers, as well as the teaching material.

4. **JISC Higher Education Academy, UK OER Program, United Kingdom:** The UK OER Synthesis and Evaluation program provided funding and support to stakeholders, which included individuals, communities and institutions, to share their learning resources openly in several projects in the UK. The program consisted of three stages to investigate issues affecting the release, use and re-use of OER. Different types of student engagement emerged from the program for creating, releasing, testing and evaluating resources that resulted from OEP.

   Adopting OEP during the program phases also showed evidence that student engagement in OER initiatives and linking OER use to student learning through digital literacy activities helped to raise awareness and increase demand on reusing existing OER in learning and teaching activities (McGill et al., 2013a). However, the program report showed that only a small proportion of the study group participate in generating OER, where academics focused on teaching activities, rather than considering learner-initiated activities (McGill et al. 2013b).

5. **The ChemWiki project:** Established at the University of California, Davis campus the ChemWiki project that is a multi-institutional project that has adopted a collaborative approach toward chemistry education where an open textbook environment is constantly being written and re-written by students and faculty members resulting in a free Chemistry OER to supplement and replace the conventional commercial books. (Larsen et al, 2012). The collaborative authorship provides both students and faculty with the opportunity to review, change, and comment on the material and its presentation (Allen et al, 2015). The project is a part of a larger open-access open textbooks to improve STEM education (Science, Technology, Engineering and Mathematics) at all levels of higher education ("ChemWiki: The Dynamic Chemistry Hypertext - Chemwiki", 2013).

   Content development of ChemWiki proceeds via two mechanisms, partly by students construction of raw content from the ground up and partly by faculty and experts in integration of existing online and offline material from the top down. Materials from both routes are implemented in parallel at multiple institutions and are processed through a hierarchal vetting structure involving both students and faculty to eventually ensure accuracy and reliability (Rusay et al, 2012).

> The project has started at the same time of the research reported in this thesis; however the scale of ChemWiki is multi-institutional and has wide collaboration between students, faculty and experts. Nonetheless, important lessons can be obtained from ChemWiki project in focusing on developing open textbooks based on collaborative mechanism of knowledge generation to include experts in the OER development process.

The examples above provide many insights into the proposed OER development model in this thesis. Designing a pedagogical approach and learning design, such as Student as Producer project and the UK OER program, can help with replicating the proposed OER development model in other learning environments as reusability of the proposed model is among its objectives. All projects have focused on engaging students with academics and administrative staff through harnessing these relationships where they can learn from each other during the process of generating OER. This collaboration highlights the importance of establishing communities of practice around the OER development process and raising these communities inside higher educational institutions, as discussed in Section 1.3. With regard to student-generated storytelling videos, the researchers integrated the development of OER as part of the curriculum where students' work was evaluated during the academic semester. This area of integrating the development of learning resources to the curriculum can be significant to the sustainability of the OER development process, as the production of OER will continue as the study course continues to be offered for student enrolments.

Additionally, the five projects either implicitly or explicitly refer to the adoption of OEP in its processes. For example, in UK OER program, the researchers worked on adopting OEP in different types of student engagement with OER, such as creating, releasing and evaluating OER. In the Student as Producer project, the project managers integrated OER development under university policies, which allowed the model to be replicated widely in the university (Winn & Lockwood, 2013).

However, some areas require further research. The assumption that students are tech savvy and will bring technology with them to the class as a norm requires better understanding of their experience with using content authoring software tools and previous experience with generating online content. Determining a student's previous skills can help with designing the learning approach that matches with his/her skills level. Additionally, engaging academics as co-creators in the OER development process requires an understanding of the technical skills of academics in terms of using ICT in learning and teaching. As some researchers assume, there is a digital gap between students and academics in terms of digital literacy (Prensky, 2001a).

Further, there is a need to understand the impact of integrating OER development models that engage students in the development process on advanced study units. For example, the UK OER program model was recommended for introductory study units, therefore, additional research in this area helped to extend participation in the OER development process and provide additional resources to maintain the model's sustainability on a wider scale.

2.7 Open educational resource benefits

The literature review of OER initiatives and recent reports from UNESCO emphasis the benefits of OER for society to increase access to higher education, reduce cost and enhance educational quality. These benefits were highlighted by the World OER Congress, organised by the Commonwealth of Learning (COL) and UNESCO in Paris, in June 2012 (Dhanarajan & Abeywardena, 2013), and by recent research (Mackintosh, McGreal, & Taylor, 2011; Wiley, 2012). Hodgkinson-Williams (2010) summarised the benefits of OER based on D'Antoni and Savage's (2009) report to UNESCO, and listed the following four different perspectives:

1. **Government perspective** – OER advances knowledge by making it openly available to all type of learners and allowing their participation. It also bridges the gap between formal, informal and non-formal learning by prompting lifelong learning and leveraging taxpayers' money by sharing and reuse between institutions.

2. **Institutional perspective** – Sharing knowledge is congruent with the academic mission, enhances institutions reputation and attracts new students. It can improve career pathways by helping the student to make clearer decisions about their study programs. OER initiatives provide rich resources for students and faculties by supporting learning and collaboration and attracting alumni as lifelong learners.

3. **Educator perspective** – Recognised in personal gain through increased professional skills and building portfolios of academic work. Intangible benefits are gaining publicity, facilitating and fostering connections with colleagues around the world and leaving a legacy after leaving academia.

4. **Learner perspective** – The ability to access material from the best universities in the world without any cost or location barriers. Prospective students can access institutions by looking at materials made available by academics from these institutions. Even though OER can promote informal learning where a credential is not needed, there is a new direction where learners can have their learning assessed and subsequently receive appropriate academic recognition for their efforts (Mackintosh et al., 2011).

Another perspective for the benefits of OER that needs to be highlighted is the social perspective. By establishing communities of practice in higher educational institutions around the OER development process, teachers and students can work collaboratively in building learning resources that can be shared as OER. These communities of practice evolve over the years as new cohorts of students engage in the process as a result of learning content of OER evolves and different groups of students and teachers contribute to the resources. Importantly, these communities continue to accommodate new groups during every new academic semester, and the authorship of each learning resource continues to belong to these communities rather than the individuals.

However, despite a theoretical understanding of the benefits of OEP in some of the higher educational institutions, these benefits are not being realised (Atenas et al., 2014; Falconer et al., 2013). Therefore, there is a need to provide evidence of the value of OER, OEP and openness though raising awareness of the culture of openness in higher educational institutions and engaging different stakeholders in the OER development process through establishing communities of practice around the OER development process.

2.8 Summary

For over a decade, OER development has been advancing formal and informal learning. However, integrating OER in higher educational institutions has always been challenged by the sustainability of OER projects. Chapter Two has presented the area of OER sustainability in higher education as the context of the research documented in this thesis. The chapter contributes towards identifying six elements of OER development projects that are essential for proposing a new OER development model: (i) learning material; (ii) ICT; (iii) stakeholders; (iv) institutions; (v) learning design; and (vi) intellectual property. It was found that the concept of openness has a strong influence on the integration of OER in higher education, and adopting OEP is central to OER development process. It was also suggested that the concept of the cognitive surplus has important implications for the sustainability of OER. The cognitive surplus concept is used to describe the abundance of intellectual work that is taking place in higher educational institutions, which can be tapped into as sustainable resources for the OER development process. The concepts of openness and cognitive surplus underpin the theoretical framework of this thesis. It was identified that higher educational institutions have high potential for accommodating new OER projects as running services. Therefore, it was suggested that establishing communities of practice around the OER development process, consisting of students and academics, and tapping into the cognitive surplus of knowledge production of these communities, can be a promising path for the sustainability of OER in higher educational institutions. The chapter concluded with highlighting the benefits of OER for different stakeholders and emphasised that the social benefits of OER for communities of practice of students and academics will continue to grow around the OER development process at each new academic semester.

The literature review presented in this chapter evolved and expanded over the research lifetime. Therefore, as the research followed a design-based methodology, the extended literature review of this thesis that is reported in Chapters Five, Six and Seven presents and discusses three iterations of research. Chapter Three presents the challenges of the OER and focuses on three challenges that were addressed in this study.

CHAPTER THREE:
INVESTIGATION OF OPEN EDUCATIONAL RESOURCES CHALLENGES IN HIGHER EDUCATION

3.1 Introduction

The challenges of OER witnessed over a decade ago are given high priority in any OER agenda (Glennie, Harley, Butcher, & Van Wyk, 2012; McGill et al., 2013b, p.10). Chapter Three focuses on three challenges of OER: (i) lack of awareness of the value of OER in higher education; (ii) lack of participation to OER; and (iii) concerns about the quality of learning resources published through OER, which were reported in Chapters One and Two. However, the focus on these challenges is significant for the adoption of OER in higher educational institutions, and the investigation carried out in these challenges is important when proposing a new OER development model. Chapter Three provides an in-depth analysis of the identified challenges and shows their significance to the research study and OER research.

3.2 Open educational resource challenges in higher education

This section summarises the challenges of OER development by reviewing literature of the past decade. Different stakeholders, organisations and research studies have identified and worked on addressing the challenges of OER in formal and informal learning.

Among the major stakeholders are OECD and the UNESCO International Institute for Educational Planning. According to Joyce (2007), both organisations focused on the following challenges on different organisational aspects:

1. At the academic staff level, a lack of time was reported due to academics being busy with other duties, as well as a lack of incentives to create and share learning resource, not having the technical capacity, and academic concerns of losing control over the material they produced, where others may miss using their intellectual property or making profits from their material.

2. At the institutional level, there was a lack of policies to raise awareness of OER, and a shortage of financial support and human resources willing to participate, in addition to concerns of competitions by other universities.

3. Legal and licensing issues were seen as a major barrier to OER production for both individuals and institutions. There is also lack of clarity of the term of use of online learning resource, and lack of understanding law in cyberspace and the implications of choosing different open licences.

4. Barriers related to internet access due to lack of technical infrastructure or cultural issues especially in developing countries.

The Centre for Educational Technology at the University of Cape Town and Commonwealth of Learning also played a significant role in addressing OER challenges in Africa and Commonwealth countries (Hodgkinson-Williams, 2010; Geser, 2007; Kozinska et al., 2010). Their efforts focused on the following:

1. Technical challenges, including a lack of technical infrastructure, especially within developing countries, interoperability with existing systems and reusability of content.

2. Economic challenges, including sustaining funding as a major challenge for most aspects of OER projects. The economic challenge also included other resources, such as staffing and infrastructure.

3. Social challenges imply that a lack of institutional incentives to share and publish still exists where academics are unwilling to share their intellectual property.

4. Legal challenges and lack of awareness of copyright issues in using and developing open content, as well as the fear that others may misuse their ideas or copyright.

The William and Flora Hewlett Foundation is a major supporting organisation for the OER movement. Several reports were generated and presented to the William and Flora Hewlett Foundation describing the criticality of the OER challenges (Reed, 2012; West & Victor, 2011). The challenges include:

1. Discoverability of OER as no search engine is able to search all OER.

2. Interoperability of OER in different platforms and the need for efficient methods for sharing OER of different formats.

3. Quality supply by all types of users where there is a lack of evidence of measuring high quality, good or useful openly published learning resources. The author highlighted the role of all types of user feedback that could improve the quality of learning resources.

4. Language barriers exist, as well as a need for OER technologies to support multiple languages to accommodate a wider range of users.

Finally, a recent research study (Atenas et al., 2014) investigated the voice of academics in using OER and identified the following challenges:

1. Lack of digital literacy and skills among academics who use OER and OER repositories.

2. Barriers related to the functionality and user interface design of OER repositories that make them difficult for academics to use and navigate without previous training.

3. Little training and support for academics to improve their digital skills and open literacy when engaging them with OEP.

4. Lack of institutional polices that provide ongoing training and support for encouraging academics to take part in OER development.

OER barriers that were identified almost a decade ago still exist. For example, technical barriers, legal barriers and quality issues were identified in the studies mentioned above. These barriers have caused discontinuation of many OER projects, hence, sustainability as a fundamental goal needs to be addressed from different perspectives. However, many initiatives no longer exist due to a lack of continued funding, academic reservations about their intellectual property and questions about the quality of the material produced. For example, Figure 3.1 shows the number of inactive or discontinued OER projects between 1996 and 2007 (Friesen, 2009).

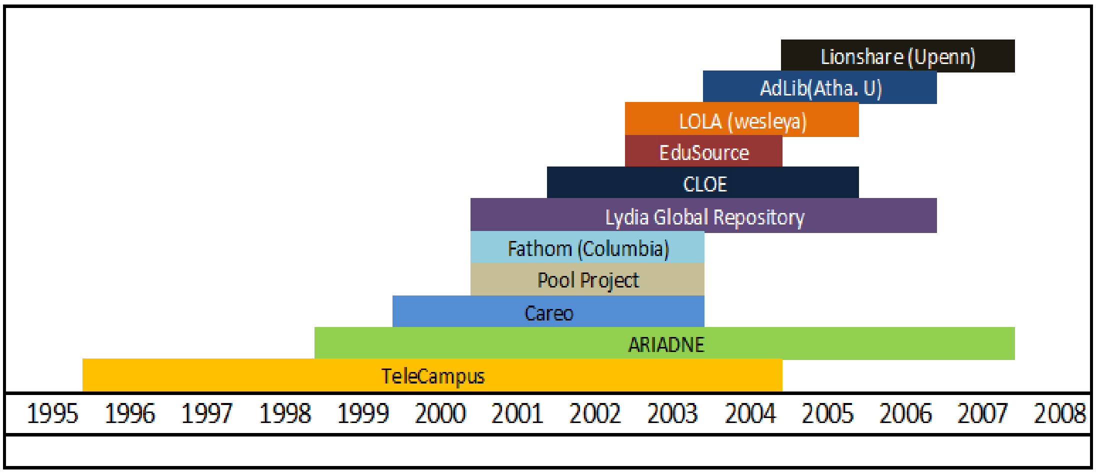


Figure 3.1: Inactive or discontinued OER projects between 1996 and 2007 (adapted from Friesen, 2009)

Figure 3.1 shows a short lifespan of OER projects with only two spanning over five years. From the 11 examples provided, Friesen (2009) identified incompatibilities of OER with institutional cultures, lack of technical ability and lack of pedagogical skills as major factors that delay the use and growth of OER in certain institutions.

Therefore, in order to propose a new sustainable OER development model, previous literature and existing challenges need to be considered. Friesen (2009) argued that there are two important lessons from the discontinuation of projects in Figure 3.1: (i) in order to maintain sustainable OER, initiatives and projects need to be treated as ‘processes or services rather than a product that persist of their own accord’ (Friesen, 2009, p. 8): and (ii) there is a high potential for the sustainability of OER to have communities of practice that develop learning resources in their specialist area and ‘that the *scope* of any collection must be matched by its *scale*’ (Friersen, 2009, p. 8).

Additionally, when proposing a new OER development model, the general area of socially constructed online systems need to be considered. From the perspective of the cognitive surplus, Shirky (2010) argued that there are important lessons that can be learnt from existing social media websites and used to reflect any new system that includes a group of people working together and creating a value for the whole community. OER projects are typical examples of such systems. Shirky (2010) suggested that for an initiative to create a real value it must go through three stages: (i) starting; (ii) growing; and (iii) adapting. The following provides the characteristics of each stage as explained by Shirky (pp. 193-207).

1. The *starting stage* recommends creating a small project and identifying how it works for a small group before expanding on it. It is also important to understand what motivates the end users to use the new system (intrinsic or extrinsic motives). This can be carried out by the designers to place themselves in the users' positions so they can understand why they will use the new system, and give end-users the opportunity to try the system and understand what would reward their motives. Shirky stressed that if a system is committed to the defaults of open sharing, people would be happy to create value for each other through that system. Hence, system growth will result in openness.

2. The *growing stage* suggests having a group of people who hold culture and being committed to that culture is essential to maintain the group size. In addition to providing a space of diverse participation, the levels of participation, which varying from very small to large, allows the system to grow and continue. As a result, a system with a large number of participants often creates clusters of participants who share specific interests. Shirky highlighted the importance of providing a supportive culture where people create opportunities for each other and understand the rules according to whom the group is acting and obeying.

3. The *adapting stage* implies the continuous analysis of the end user's feedback to understand his/her evolving needs, and act accordingly by updating the system. Facing problems as they arise and learning from them to improve the service are also important when adapting a new system. In terms of rules to be abided by, Shirky recommended creating an environment where people want to participate and allowing them to act and be part of the environment before enforcing rules. These rules are formulated out of the need that people have as a result of their interactions in the group. Finally, allowing as much experimentation as possible helps them to create new opportunities for each another.

Hence, to avoid duplication, maintaining OER sustainability in higher educational institutions needs to consider the major challenges in context. Previous history of OER initiatives clarifies important aspects that need to be considered when proposing a new OER development model. As previous OER projects were established in higher educational institutions, these environments present diverse assets, such as human resources, technical support and funding. To maintain OER sustainability, building communities of practice that are committed to running OER as services in higher educational is required. Additionally, developing a new OER model needs to take place in stages where each stage informs the next stage before the complete service is adopted in an institution. This gradual development will help stakeholders to assess the feasibility of a new OER development model and understand how the model will work in practice before enforcing its conditions.

3.3 Focus of the investigation

Although there exist many initiatives advancing OER projects, there is still a high demand to address the challenges of raising awareness of OER, expand the participation base and improve the quality of OER (Glennie et al., 2012). These challenges continue to appear on the agenda of OER World Congress organised by UNESCO in 2012. In this thesis, a new OER development model is proposed and evaluated that aims to address these three challenges: (i) raising awareness in higher educational institutions between academics and students through adopting OEP; (ii) expanding participation through engaging students in the process of developing learning resources for OER; and (iii) improving the quality of the learning resources through the development process.

The three challenges are the major focus of this research due to their significance for adopting OER in higher educational institutions and to the context of the SCEM at WSU, because adopting OER in learning and teaching is a new strategy for the school.

Raising awareness of the value of OER in higher education can motivate higher educational institutions to take part in the process and contribute to their learning resources that will help sustain the OER projects. In this context, higher educational institutions can contribute to expanding the depth and breadth of OER that can be shared by learners around the world. Hence, creating diverse group of participants to OER can increase the value of OER, attract contributors and expand the resource base.

Expanding participation to OER development is a challenge that needs to be addressed as more people become involved in the diverse learning resources that OER can host. Participation from higher educational institutions can include teachers and students. The focus in this study to expand collaborative participation by students as content creators and teachers as co-creators can save costs for OER projects on the budget allocated for human resources. Importantly, by ensuring that participation to OER development is part of the learning process, students will become engaged in generating the learning resources. A remarkable outcome from an OEP study in the UK showed that student participants as collaborators and co-creators of OER as a shift from being consumers of the learning content to produce provided a key indicator for a potential long term impact (McGill et al., 2013b).

The third focus of OER challenges in on the quality of OER published. The success of OER depends on the quality of the content shared. Providing learners with quality learning resources can save the money they spend on buying textbooks, therefore, allowing students to use OER as their main learning resources for university studies. The challenge is also important for OER if used as a secondary resource, because this can save students the time and effort trying to locate reliable learning resources, especially with the wide proliferation of information that is available through the internet.

The following points present a closer analysis of the three challenges at specific and more significant levels to this thesis:

1. **Raising awareness of openness in higher education**: This challenge has been highlighted as the main issue in literature (D'Antoni & Savage, 2009) among the policies that need to be adopted to support OER (OECD, 2007a) and underpins the promising path of OER to improve education. The concern continues to appear on the top of the agenda in the OER World Congress organized by UNESCO in June 2012:

   > *Item a. Foster awareness and use of OER. Promote and use OER to widen access to education at all levels, both formal and non-formal, in a perspective of lifelong learning, thus contributing to social inclusion, gender equity and special needs education. Improve both cost-efficiency and quality of teaching and learning outcomes through greater use of OER.* (Pawlowski & Hoel, 2012, p. 3)

   This challenge is addressed in this study through raising awareness in the undergraduate learning environment through conducting workshops for students, meetings with their teachers, and establishing incentives to participate in the OER development.

2. **Lack of participation in OER development:** A major reason this challenge is related to is a lack of understanding the open licensing framework among academics in higher educational institutions. The concern also appears on the agenda of the OER World Congress in three separate items that relate to this challenge of lack of participation:

> *Item d. Promote the understanding and use of open licensing frameworks. Facilitate the re-use, revision, remixing and redistribution of educational materials across the world through open licensing, which refers to a range of frameworks that allow different kinds of uses, while respecting the rights of any copyright holder*
>
> *Item g. Encourage the development and adaptation of OER in a variety of languages and cultural contexts. Favor the production and use of OER in local languages and diverse cultural contexts to ensure their relevance and accessibility. Intergovernmental organisations should encourage the sharing of OER across languages and cultures, respecting indigenous knowledge and rights.*
>
> *Item j. Encourage the open licensing of educational materials produced with public funds. Governments/competent authorities can create substantial benefits for their citizens by ensuring that educational materials developed with public funds be made available under open licenses (with any restrictions they deem necessary) in order to maximize the impact of the investment.* (Pawlowski & Hoel, 2012, pp. 4, 6-7)

This challenge could be addressed through building collaborative communities of practice for teachers and students, and engaging them in the OER development process as a part of the learning process and pedagogically informed teaching approach.

3. **Quality of OER produced:** This challenge is addressed by developing quality OER that adhere to a set of technical, educational and openness quality criteria of learning resources, in addition to harnessing teachers' skills in designing learning resources and adjusting the learning content accuracy and students' enthusiasm towards using ICT in the learning process.

> *Item e. Support capacity building for the sustainable development of quality learning materials. Support institutions, train and motivate teachers and other personnel to produce and share high-quality, accessible educational resources, taking into account local needs and the full diversity of learners. Promote quality assurance and peer review of OER. Encourage the development of mechanisms for the assessment*

> *and certification of learning outcomes achieved through OER.*
> (Pawlowski & Hoel, 2012, p. 5)

The main aim of addressing these challenges is to develop a sustainable OER development process model for higher educational institutions that supports their competitiveness. Nonetheless, the research also aims to improve the learning performance of students through establishing communities of practice around OER within higher educational institutions and to engage students in developing OER as part of the learning process. Therefore, the theoretical objectives of this research include identifying the area of student-generated content as sustainable resources for OER development process and generating the final design principle of the OER development model. On the other hand, the practical objectives consists of providing evidence of the efficacy of the OER development model in educational settings and establishing communities of practice around OER in higher educational institutions. Hence, a research methodology is required to address the theoretical and practical objectives. A DBR methodology was adopted because it is useful in TELE to address practical problems through integrating technological applications (Wang & Hannafin, 2005) with the purpose of refining the theories (Luo, 2011). Chapter Four extends on the definition of DBR methodology and presents the rationale behind selecting a DBR to address the OER challenges and development of the proposed OER development model.

3.4 Summary

The literature review shows that integrating OER in higher educational institutions has remarkable benefits for learners and educators, however, there are also significant challenges that limit this integration in the educational setting. In this thesis, the focus is on addressing the three challenges: (i) raising awareness of OER and the value of openness in education; (ii) lack of participation to create and generate OER; and (iii) the concern of quality of the learning resources published through OER. Addressing these challenges in real-life educational settings can provide practical evidence for integrating OER in higher educational institutions. However, to realise the benefits of integrating OER in higher educational institutions and responding to the challenges that limit this integration, there is a need to propose an initial solution and integrate it into real-life educational environment in a way that engages students and teachers in the OER development process. The solution needs to be reusable by other institutions to implement their own OER projects. Chapter Four presents the methodology of how the investigation for proposing a new OER development model that can be integrated into higher educational institutions will be implemented.

CHAPTER FOUR:
DESIGN-BASED RESEARCH METHODOLOGY AS A RESPONSE TO OPEN EDUCATIONAL RESOURCES DEVELOPMENT CHALLENGES

4.1 Introduction

The aim of the research study in this thesis is to address three main challenges of the OER in higher education: (i) raising awareness of the value of OER and openness; (ii) expanding participation in generating OER by engaging students in the development process; and (iii) addressing the concerns of the quality of OER. Among the objectives to achieve this aim is to develop a sustainable OER development model by generating a set of reusable design principles that can be used by other higher educational institutions, and to provide a practical evidence of the efficacy of the proposed OER development model in a real-life educational setting, as discussed in Section 1.6 . As these objectives are theoretical (i.e. generating a reusable design principles) and practical (i.e. practical evidence of model integration in real-life settings), a research methodology that can guide the research to achieve both objectives is required. Hence, design-based research (DBR) is selected because the methodology serves to contribute to the theory and provide a practical guide for design solution in TELE (Wang & Hannafin, 2005).

Chapter Four provides a review of using DBR methodology for TELE and shows the rationale behind selecting the research study that is documented in this thesis. The chapter also serves as a guide for adopting DBR in similar studies that can be reused by other researchers who wish to adopt the same methodology in similar educational settings.

4.2 Design-based research methodology

DBR methodology started to evolve in 1992 from the works of Brown (1992) and Collins (1992) who referred to DBR as a ‘design experiment’. Both researchers relied in their work when they assumed that educational theories should be tested and developed in learning environments rather than in laboratory-based examinations. They suggested that researchers need to find real life educational settings to test their proposed interventions and to determine if these interventions were capable of improving learning and teaching. In DBR, researchers usually employ a blend of quantitative and qualitative methods, where they can work closely with participants to help bridge research and educational practice (Barab & Squire, 2004; Reeves, 2006; Design-Based Research Collective, 2003).

It was not until the end of the 20th century that qualitative research methods as an approach dominated research in education and educational technology (Willis, 2008). However, Willis (2008) strongly stated that collected data in quantitative or qualitative approaches is not as fundamental as the paradigms that lead the research process. Hence, it was important to research different types of research methodologies in the area of educational technology research to identify an appropriate one to guide the design development, implementation and evaluation in this research study.

According to Wang and Hannafin (2005) DBR methodology is defined as:

> *… a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories.* (Wang & Hannafin, 2005, p. 6)

DBR methodology helps to create and extend knowledge about developing, enacting and sustaining innovative learning environments. Reeves (2006) identified important advantages of DBR as requiring 'collaborative work between practitioners and researchers to identify the existing problems, and creating a initial design solution based on testing and refining the initial solution in practice until satisfactory outcome reached by all stakeholders' (Reeves, 2006, p. 59).

DBR consists of four phases as in Figure 4.1, with each phase informing the next and previous phase in iterative manner where a solution is proposed initially and refined through iterative cycles of evaluation and testing solution in practice.

Anderson and Shattuck (2012) analysed 47 articles that used or focused on DBR between 2002-2011 which resulted in identifying quality of DBR as:

1. Being situated in a real educational context to be able to assess the results and reflect on similar learning context.

2. Focusing on the design and testing of a significant intervention in practice, as the design of the intervention is a key feature of the quality and the results of the project.

3. Using mixed methods, multiple iterations, a collaborative partnership between researchers and practitioners and evaluation of design principles.

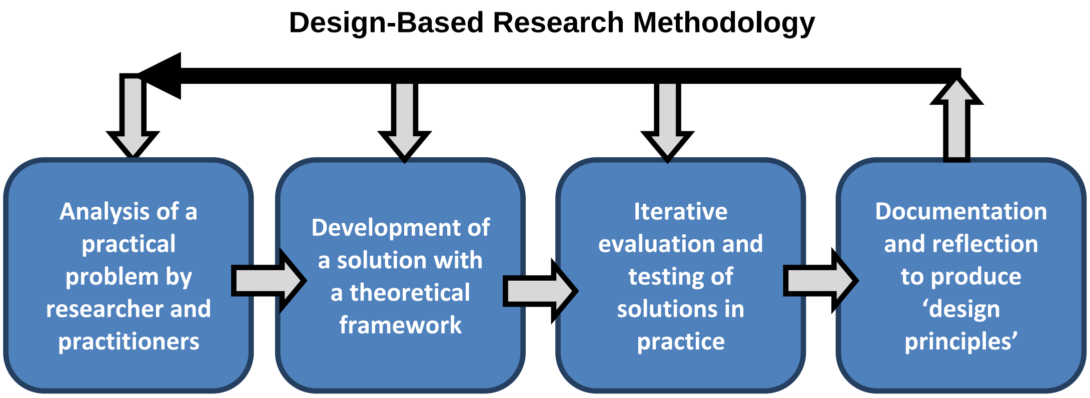


Figure 4.1: Design-based research in educational technology (Reeves, 2006)

Therefore, addressing a complex educational problem, such as sustaining the OER development process in higher educational institutions, requires careful understanding of how the proposed solution works in real life settings. Integrating the intervention within the learning curriculum and repetition of the experiment helps to evaluate and refine the initial design principles. Furthermore, as this model aims to address the challenge of quality of learning resources published via OER, DBR responds to this challenge as it involves different stakeholders in the experiments, which helps in adjusting the quality of the learning resources during the evaluation stage and refining the solution based on the previously conducted iteration.

4.3 Rationale behind adapting the design based research methodology for open educational resource research

The DBR methodology has considerable potential in educational technology research (Wang & Hannafin, 2005). Randolph (2007) and Luo (2011) identified DBR among the major methodologies used in the area of educational technology. In this study, DBR guides the concurrent and iterative refinement of the intervention and research practice. This guidance is conducted over four phases of the DBR methodology: (i) identifying the problems in OER literature and what has been witnessed in learning environment; (ii) proposing initial design for OER development process based on a theoretical framework; (iii) evaluating the solution in practice through iterative cycles of research implementation; and (iv) proposing final design principles that can be reused in higher educational institutions.

Barab and Squire (2004) described the features of DBR methodology by comparing it with psychological experimentations that took place in laboratories. These features were found to reflect the challenges of OER, as identified in Chapter Three. The following points, based on the features of DBR as identified by Barab and Squire (2004), show how DBR methodology can address the challenges of OER development and provide justification for adopting DBR:

- Occurs in real-life settings where most learning actually happens. Therefore, developing a solution for OER in higher educational institutions requires the implementation of the solution in real life educational settings and integrating the solution as a part of the learning assessment (Geser, 2007).

- Involves flexible design revision in which there is a tentative initial set that is revised, depending on its success in practice. Lessons learned from previous OER projects involve identifying how it works for a small group of people and then expanding the group (Friesen, 2009; Shirky, 2010). Hence, designing a new solution must allow for several trials of the system and then acting upon it based on the results.

- Frequently involves complex social interactions with participants sharing ideas and distracting each other. A lack of participation by academics in developing OER is a challenge that requires wider community engagement in the OER development process (Pawlowski & Hoel, 2012).

- Involves looking at multiple aspects of the design and developing a profile that characterises the design in practice. Several OER development models have been developed and in use by higher educational institutions, which sustainability depends on institutional or seed funding (Downes, 2007; West & Victor, 2011). However, when funding is exhausted (Johansen & Wiley, 2011), characterising the design solution in a real life setting helps to identify different aspects of the OER development that maintains the sustainability of the proposed solution.

- Involves participants from different backgrounds in the design so that their varying expertise is involved in producing and analysing the design. The lack of participation by academics in sharing their learning content freely on the internet has been identified in OER literature, therefore, there is a need to find alternative solutions to engaging academics in OER content creation and inviting new community members to contribute to these projects (D'Antoni & Savage, 2009; Hodgkinson-Williams, 2010).

- Involves multiple dependent variables, including climate variables (e.g. collaborating with the wider community), outcome variables (e.g. developing and publishing OER) and system variables (e.g. publishing OER and maintaining sustainability of the solution).

- Focuses on characterising the situation in all its complexity, much of which is not known a priori. The current research focuses on three major challenges: (i) raising awareness; (ii) engaging new participants; and (iii) addressing the quality of learning resource published as OER that are significant for the OER development process as OER continue to emerge among OER literature. Therefore, addressing these challenges by involving variables in the design will help characterise a solution that will contribute to sustaining OER in higher educational institutions.

In DBR, educational intervention needs to demonstrate the value of the design in creating an impact on learning in real-life educational settings (Herrington, McKenney, Reeves, & Oliver, 2007) and contributing to the theory that has been used to inform the design model (Barab & Squire, 2004). DBR methodology has the ability integrate the OER development model in learning environments and to provide evidence of the impact of the solution on the learning process. In addition, the iterative nature of DBR includes repetitive revision of the literature in context of the respective iteration of developing the solution. Therefore, developing the solution reflects back and contributes to the body of literature of OER development in higher education.

4.4 Overview of using design-based research methodology

DBR is a systematic and flexible research approach that takes place in an iterative manner. It consists of four phases that help to develop solutions in TELE. However, it is important to clarify the definitions used in describing the research processes:

1. **TELE:** Wang and Hannafin (2005) defined TELE as 'technology-based learning and instructional systems through which students acquire skills or knowledge, usually with

the help of teachers or facilitators, learning support tools, and technological resources' (p. 5).

2. **DBR:** The research methodology adopted for the research and presented in this thesis.

3. **Intervention:** Intervention is defined as 'the systematic process of assessment and planning employed to remediate or prevent a social, educational, or developmental problem' (Farlex, n.d.) In the context of TELE, intervention can be defined as a set of instructions used to scaffold learning and the teaching process when working with ICT.

4. **Iteration:** Iteration is a set of four phases in DBR, usually associated with a period of time, such as an academic semester. The design principles obtained at the end of the fourth phase are reused to modify the initial design as the solution is usually insufficiently detailed for designers to make the necessary changes (Wang & Hannafin, 2005), hence, the effectiveness of the solution is evaluated in practice in the educational settings.

5. **Phase:** A phase is a stage of iteration where each phase has a certain number of tasks that must take place before the next phase starts.

6. **Cycle:** As practical implementation of the intervention in real educational settings takes place, a cycle occurs in Phase Three of an iteration.

The structure of the DBR methodology adapted for this research is presented in Table 4.1. The table is organised based on guidelines for using DBR in doctorate research, as suggested by Herrington et al. (2007). The first column shows the DBR phases based on Reeves (2006), and the remainder of the table briefly summarises the work carried out during the three iterations on each phase.

Phase Three shows the five cycles conducted as each cycle represents the implementation of the model in one study unit. Iteration 0 consists of Cycle 1 in Phase Three, which shows the initial implementation of the OER development model in the 'Introduction to IT' (300134) unit. Iteration 1 consists of Cycle 2 in Phase Three, which also repeats the implementation of the modified OER development model in the same study unit of Cycle 1.

Table 4.1: Design-based research methodology for the OER development model (based on DBR methodology as presented in Herrington et al. (2007) and Reeves (2006))

Phases in DBR	Iteration 0 Spring 2012 Starting stage	Iteration 1 Autumn 2013 Growing stage	Iteration 2 Spring 2013 Adapting stage
Phase One Analysis of practical problems by researchers and practitioners in collaboration	Literature review, and establishing the research niche and identify the gap and the problems to be addressed and the research questions to be answered	Additional review of literature (i.e. participants' characteristics) to help with improving the initial solution	Additional review of literature of learning theories
Phase Two Development of solutions informed by existing design principles and technological innovations	Developing initial solution to the existing problem based on the theoretical framework	Modifying the design based on theoretical framework and previous iteration	Modifying the design based on theoretical framework and previous iteration
Phase Three Iterative cycles of testing and refinement of solutions in practice	Cycle 1: Introduction to IT	Cycle 2: Introduction to IT	Cycle 3: Introduction to IT Cycle 4: Foundations of Statistical Modelling and Decision Making Cycle 5: Data Mining and Visualisation
Phase Four Reflection to produce 'design principles' and enhance solution implementation	Documentation and reflection on the initial design principles	Refined design principles	Generating the final design principles

The final iteration in the research was Iteration 2, which consists of three cycles, Cycle 3, Cycle 4 and Cycle 5. Iteration 2 shows the implementation of the modified OER development model in three study units, including the previously participated 'Introduction to IT' (300134) unit in Cycle 3, 'Foundations of statistical modelling and decision making' (300606) unit in Cycle 4 and 'Data mining and visualisation' (200036) unit in Cycle 5. All participated units are offered at the SCEM at WSU.

In DBR methodology, modification and reflection can happen in all four phases (Wang & Hannafin, 2005). For instance, after each iteration, modifications require the researcher to return to the literature (i.e. Phase One) and look for additional theoretical areas that support the design, until eventually reaching design principles that best describe how the design performs in an educational setting. Several modifications took place in different occasions of the research life time of this thesis, each helping to improve the final design principles of the intervention. For example, in data collection, an additional survey was used in Iteration 2 of the research, as the need arose for a better understanding of the learning experience from the student's perspective, which was also important to reflect on his/her learning performance. Nonetheless, additional iterations can optimise the extent to which the final design principles can describe the OER development model implementation in educational settings, as there will always be room for improvement. However, recommendations by Herrington et al. (2007) for adopting DBR in doctorate studies justify that two to three iterations can lead to sufficient evidence of how an intervention can improve the learning process, and how theory links to real life settings.

Chapter Three presented the sustainability challenge of OER development. The chapter also showed that in order to propose a new OER development model there are important lessons that need to be learnt from the history of OER and the development of online social systems. The DBR methodology can significantly help with addressing these lessons in its iterative nature. Initially, to propose a new OER development model, establishing communities of practice in higher educational institutions can be carried out through collaboration between stakeholders in the OER development process. After successful establishment, these communities can enable institutions to provide the OER as a continuous service. Section 3.2 presented Shirky's (2010) arguments about developing new social systems for the community and showed that for an initiative to create a real value, it must go through three stages: (i) starting; (ii) growing; and (iii) adapting.

In this thesis and in alignment with DBR methodology, the first iteration of the research (Iteration 0) marks the starting stage of the OER development model. Shirky (2010) argued that the key to start a new project is to start small, as projects of a small scale help users to understand how the project will operate and what would motivate them to n participate. In the proposed OER development model, the starting stage is in Iteration 0 where one study unit has been engaged in the research study. The engagement on a small scale also helped the initial implementation of the model in real-life educational settings. Iteration 0 also helped to understand the behaviour of students and their teachers in the OER development process. Additionally, adopting OEP in utilising OER in the development process helped with raising awareness of openness among participating students.

Therefore, Iteration 0 is treated as a pilot study to assess the feasibility of the proposed solution. The reasons for conducting a pilot study are: (i) assessing the feasibility of the processes that are key to the success of the main study, (ii) assessing the time and resources needed, including related problems that can occur during the study; (iii) managing human resources, data and challenges that can occur; and (iv) assessing the intervention effects on the participants and the environment (Thabane et al., 2010), all of which are relevant to implementing the proposed OER development model in Iteration 0 (Table 4.1).

Iteration 1 labels the growing stage of the OER development model. It represents the modified design principles based on Iteration 0 in real-life educational settings. It was important for Iteration 1 to maintain the OER development model as part of the curriculum of the same unit of Iteration 0, hence, the 'Introduction to IT' unit was engaged (Table 4.1). Collecting additional data about student skill levels in generating learning resources helped with understanding the type of learning and technical scaffolding needed in the OER development process.

Eventually, all modifications were carried out to Iteration 2, which represented the adapting stage where the purpose was to evaluate the model on a wider scale. Further data was collected in Iteration 2, where the scale of participation was expanded to engage another two units in the research (Table 4.1). As Iteration 0 and Iteration 1 provided substantial feedback about how the OER development model works in practice, additional rules were enforced in terms of publishing the learning resources. Additionally, student-generated learning resources were tested through the evaluation process by external experts.

Reeves (2006) emphasised that the role of DBR in educational technology is to show how intervention improves the learning performance for learners and derive the design principles that can inform future research. Hence, even though the iterations of DBR are of an intertwining nature, if Iteration 0 can be labelled as the starting stage that assesses the feasibility of conducting the proposed intervention, then Iteration 1 can be seen as the growing stage, and Iteration 2 can be described as the adapting stage. In this thesis, the researcher is providing the design principles of the proposed OER development model that can be implemented in higher educational institutions. The solution also recommends the tools required to scaffold implementation and the learning process, as well as provides analysis of how does the model affect student learning performance.

Figure 4.2 summarises the research methodology documented in this thesis as it incorporates DBR methodology from Figure 4.1, the research description in Table 4.1 and labelling the three iterations.

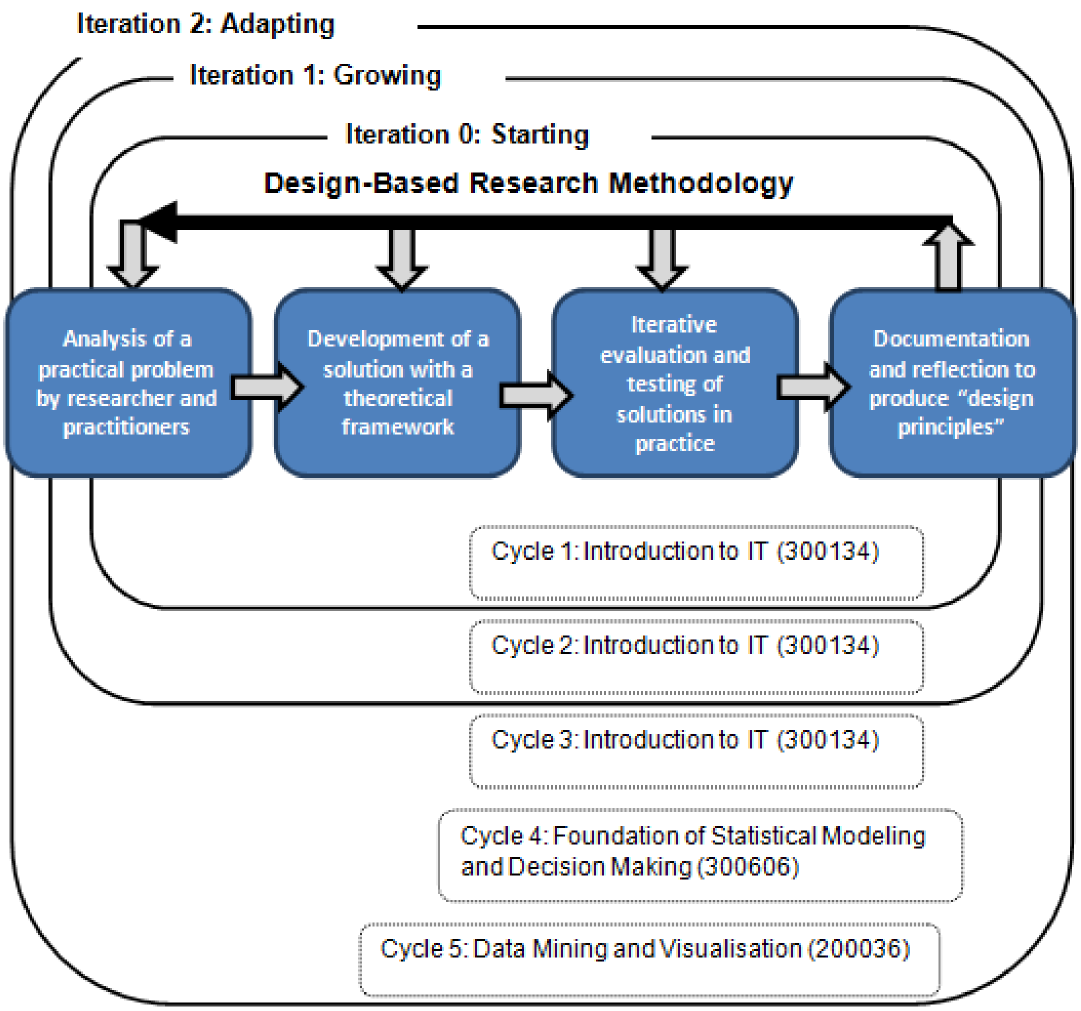


Figure 4.2: Adoption of the DBR methodology in the OER development model

The final outcome of DBR is a set of design principles (Anderson & Shattuck, 2012; Collins, 1992). Producing the final design principles will allow the model to be reused in learning environments similar to those that were investigated by the researcher. The following sections briefly describe the adoption of DBR during the research. Each section presents one phase of the research that is associated with DBR methodology.

4.5 Phase One: Analysis of the Problem

In DBR, the first stage starts with identifying and exploring a significant educational problem through collaboration between stakeholders, including researchers and practitioners (Herrington et al., 2007). Anderson and Shattuck (2012) described the collaboration between different stakeholders in a design-based study as an important step that mixes researchers' experience in conducting a research with the knowledge, objectives and politics of an educational environment that teachers possess. This collaboration can help with measuring the impact of the intervention on the learning environment, and narrowing down the focus of the research study. Therefore, in this study, collaboration with stakeholders helped with identifying the challenges of integrating the proposed OER development in the context of higher educational learning environment as described in Chapter Three of this thesis.

Phase One also takes place with the revision of the literature in order to identify what is already known about the problem, and to help with proposing the initial design solution. Herrington et al. (2007) argued that even though the initial principles that will guide the design of the intervention are largely based on the literature review, it is unlikely that they will be completed when the research begins. Hence, due to the iterative nature of DBR, the theoretical framework continued to evolve in parallel with the practical part of the research. For example, assessing the quality of the learning resources required investigation into other areas, that is, it was significantly crucial to assess the fitness of student-generated learning resources to OER. Therefore, during the research study of this thesis, the need arose for investigating into the areas of evaluation criteria of online learning resources. This investigation led to the development of a new set of evaluation criteria of student-generated learning resources.

The Design-Based Research Collective (2003), a group of researchers engaged in DBR, viewed DBR as a methodology that goes beyond straightforward designing and testing of an intervention, and that the theoretical framework plays a significant role in informing teaching and learning, as well as clarifies the relationships among theory, designed artefacts and practice. At the same time, research on specific interventions can contribute to theories of learning and teaching.

For example, student-generated content is identified in Section 2.6 as sustainable resources for the proposed OER development model. As an outcome of project-based learning, student-generated content is explored through the lens of constructivism. The project-based learning as a constructivist learning approach (Tamim & Grant, 2013) reflects students learning based on previous experience (i.e. their experience with using new technologies, student-generated content and user-generated content) and how students construct the new knowledge (i.e. student-generated learning resources) by linking with their previous experience. Therefore, the proposed OER development model is designed during the research process to accommodate constructive learning activities in which student become engaged in developing learning resources that can be shared as OER, as well as a part of the learning process. Therefore, in addition to improving the proposed OER development model, the findings reflect on student-generated content where students show motivation to share the knowledge they construct inside the classroom through OER.

4.6 Phase Two: Development of solutions with a theoretical framework

Phase Two summarised the theoretical framework through which the challenges facing OER development presented in Phase One were investigated. Therefore, one of the responsibilities of the designers in DBR is to consider design principles of existing technology enhanced innovations, which led to proposing the initial design principles (Reeves, 2006). The main outcome in Phase Two is the initial design principles being evaluated in practice through iterative cycles of Phase Three. In this study, the initial design solution was represented in the initial design of the OER development model, consisting of three stages:

1. Building learning resources
2. Evaluating student-generated learning resources
3. Publishing learning resources as OER

Based on existing literature reviews, it was feasible at this stage to propose a draft design model as an initial solution. The iterative feature of DBR helped with the evaluation and refinement of the solution based on the outcome of each iteration.

4.7 Phase Three: Iterative cycles of evaluating and testing the solution in practice

Phase Three in DBR focused on implementing and evaluating the proposed solution in practice (Herrington et al., 2007) as this phase leads to the refinement of the proposed design based on feedback from phases one and two, and helped to generate the final design principles in Phase Four. In DBR, several iterative cycles took place in an educational environment. Each cycle consisted of practical integration of the design model in the learning environment with the engagement of the researcher with participants. As Herrington et al. (2007) stated, ‘DBR is an approach that allows the interaction of different variables in the same environment of study, using mixed methods in data collection and data analysis’ (p. 7). This triangulation helped to clarify the actual image of the design model implementation in real life contexts, and led to the final design principles generated at the conclusion of the inquiry.

Data collection was triangulated to include several data resources in order to capture different dimensions of the same learning environment and to answer the research questions. The data collection tools were designed beforehand and used in the five cycles over the three iterations during research lifetime. For each data collection tool the process of data collection was also prepared in advance for both quantitative and qualitative data collection methods as following:

1 Quantitative data collection

- Online survey. The survey data collection tool is known as structured method for gathering information from entities for the purpose of generating quantitative descriptors of the variables of the larger population of which the entities are members (Jansen, 2010). Two surveys were designed for the research enquiry. The primary aim of the survey was to collect data about student experiences in using content authoring software tools, user-generated content and student-generated content. The online survey was designed and tested using online survey generator (see www.SurveyGizmo.com). The tool also provides flexibility in data preparation for analysis. In this research an online survey was piloted in Cycle 1 of Iteration 0, and the modified online survey was used in Cycle 2 of Iteration 1 and in Cycle 3 of Iteration 2, which is the final iteration of the conducted research reported in this thesis. Another online survey (i.e.: Survey 2) was used at the end of the research at Iteration 2 to collect participants’ feedback on integrating the OER development model as a part of the study unit.
- Formative assessment. Formative assessment methods are among the most influential methods to raising overall levels of student achievement. In quantitative and qualitative research on formative assessment it was concluded that formative assessment is the most important interventions for improving learning and among the largest ever reported educational interventions (Black & Wiliam, 1998).These

findings provide a strong evidence for the use of formative assessment in understanding students gain of learning and teaching approaches. In this research data was collected from formative assessments and used in Cycle 4 and Cycle 5 of Iteration 2 of the research.

- Project based learning assessment. As a model that organises learning around engaging students in developing projects, project-based learning is adopted in the OER development model that involves students in generating learning resources and share openly via OER. The evaluation process of these projects was used to collect data about the quality of student-generated learning resources over the five cycles of the three iterations of the research.

2 Qualitative data collection

- Literature review. A literature review enables the researcher to make use of previous work in the field under investigation and provides invaluable insight into the area being evaluated. Literature review is used to identify previous evaluation criteria of online learning resources, which include but not limited to learning objects, open educational resources and online learning courses. The process involves revising of exiting literature, content analysis of evaluation criteria and generating new evaluation criteria that can be used in the evaluation of student-generated learning resources. The literature review of research in evaluation criteria of online learning resources is utilised in Iteration 2 of the research reported in this thesis.
- Interviews. As a data collection tool, open interviews were conducted to collect participants feedback and subsequently analysing of their responses. At Iteration 2 of the research interviews were used to collect feedback of the unit coordinators on integrating the OER development model as a part of the learning design of the study units involved in the research. Additionally, the interviews helped with verification of the feedback received from students in the online survey (i.e.: Survey 2) on the efficacy of the OER development model as a learning approach, and making recommendations for the future.

4.8 Phase Four: Documentation and reflection to produce design principles and enhance solution implementation

Phase Four, the final phase of the DBR methodology, involved documenting work that took place, which included reflections of the researcher on the integration of the intervention in educational settings. Phase Four also included generating the refined design principles to produce the final design principles of the OER development model (Reeves, 2006). This included producing the design principles of implementing a sustainable OER development model in higher educational institutions and all its components that support the design. The principles were developed based on the outcome of the iterations and by re-examining the literature, as well as through collaboration between the researcher and participating unit coordinators.

4.9 Summary

Chapter Four presented an overview of DBR methodology in the context of student development of OER as part of student learning process, and the four phases of this methodology that were adapted to address the challenges identified in the area of OER development process. DBR methodology provides 'best practice stance' in complex learning environments (Dede, Ketelhut, Whitehouse, Breit, & McCloskey, 2009). For over a decade, DBR methodology is used in educational learning environments, however, Anderson and Shattuck (2012) stated that there is a need for more evidence to clarify how results from DBR studies meet with the challenges of prompting widespread adaptation of tested interventions. Therefore, Chapter Four presented guidelines on adopting DBR methodology. Nonetheless, these guidelines can be reused by other researchers interested in employing DBR for investigating the integration of technological interventions in learning environments.

Through the adoption of DBR methodology in the research documented in this thesis, each phase responded to the development of the proposed solution that addressed the challenges of OER development process. Therefore, the OER development model has been developed and refined over three iterations following DBR. Phase One concerned the process of problem analysis based on existing literature reviews, Phase Two showed how the initial design model has been generated with collaboration between the researcher and stakeholders, Phase Three summarised how the model has been implemented and evaluated in real life setting through iterative cycles, and Phase Four led to the final design principles of the OER development model. The research was conducted over three iterations, each included the four phases and iterative cycles of model implementation in real life settings. Further details of the methods, participants, data collection and data analysis are provided in subsequent chapters, as described in Table 4.1 and Figure 4.2. Chapter Five presents Iteration 0 of the research, which focused on the initial implementation of the proposed OER development model in one study unit, followed by Chapter Six presenting Iteration 1 and Chapter Seven presenting Iteration 2 of the research.

CHAPTER FIVE:
STARTING STAGE OF THE OPEN EDUCATIONAL RESOURCES DEVELOPMENT MODEL – ITERATION 0

5.1 Overview

As stated in Chapter Four, DBR starts with the identification and exploration of a significant educational problem through collaborations between researchers and practitioners. This chapter presents Iteration 0 of the research. As stated earlier in Chapter Four, Iteration 0 labels the starting stage where the feasibility of the proposed solution is assessed. The actual work was conducted during the period of academic semester August to November 2012. Figure 5.1 presents a summary of the starting stage.

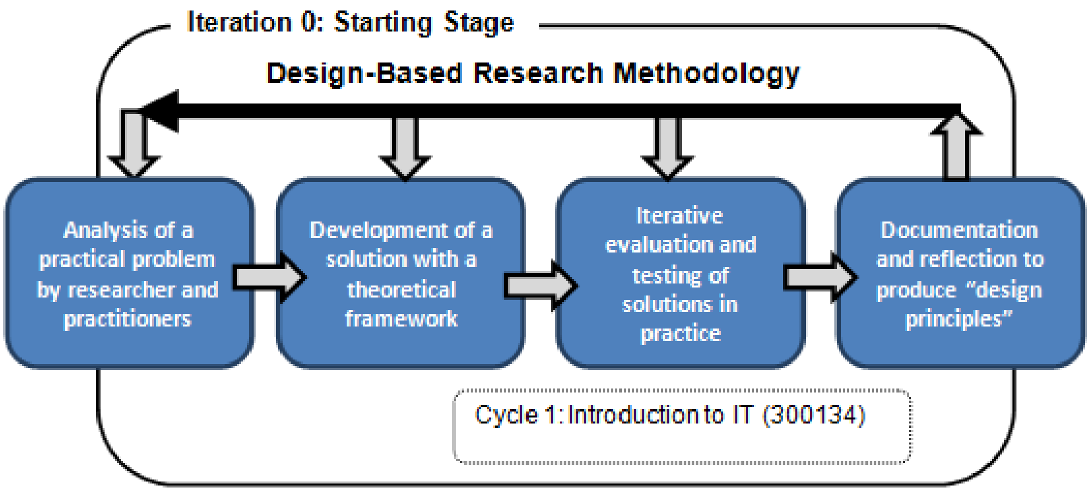


Figure 5.1: Starting stage of the OER development model

This chapter is designed to align with the four phases of the DBR methodology as represented in Figure 5.1 that presents the development of the OER development model over Iteration 0.

5.2 Phase One

In Phase One of the DBR methodology, the analysis of a practical problem took place by the researcher and practitioners in reviewing and analysing existing literature, and investigating practical problem in real educational settings.

The collaboration between different stakeholders represented an important mix of experience and knowledge in the field. In the conducted study documented in this thesis, Phase One of the starting stage helped to explore the undergraduate educational environment of the proposed solution. This exploration showed a wide range of study units offered from the SCEM blending the use of ICT in project-based learning approach. Importantly, there were evidence of an abundance of student-generated content that needed to be repurposed with the proposed solution. The main stakeholders in this phase were the researcher and unit coordinator of the selected study unit. The unit coordinator is known at WSU as an academic staff member responsible for academic administration matters related to the unit and students enrolled in that unit, who can also teach in the same unit, that is, Iteration 0, participating study unit ‘Introduction to IT’ (300134) from the SCEM at WSU. A unit at WSU is equivalent to one course offered in one academic semester elsewhere.

The involvement of the unit coordinator helped with defining the area in which OER challenges can be addressed, particularly the undergraduate learning environment. For example, adopting OEP and OER are new areas to the learning environment and therefore require raising awareness of these concepts. Additionally, an investigation into the abundance of student-generated content in study units that include a project-based learning approach as part of unit assessments was also required at this phase. This investigation collected evidence of the existing problem of student-generated content that has been rarely tapped into, even with creative projects that could eventuate. For example, at the beginning of Iteration 0, the unit coordinator of ‘Introduction to IT’ unit (300134) explained about the large number of projects that students create every semester through using software tools, but remain untapped at the end of the semester. This surplus of student-generated content has been highlighted by several researchers to encourage finding new pedagogically informed approaches to tap into it (Bates, Hardy, Kaye, Galloway, McQueen, & Kirsop, 2012; Bull, 2008; Kearney, 2011; Sener, 2007; Wheeler, S., Yeomans, & Wheeler, D., 2008). In the following subsections, the area of openness in education and student generated content are explored in more detail. The extended literature review also provides analysis of the concept of cognitive surplus and its implications for the proposed OER development model. Figure

5.2 shows the literature map of Phase One of Iteration 0. The following subsections present the analysis of this part of the literature review.

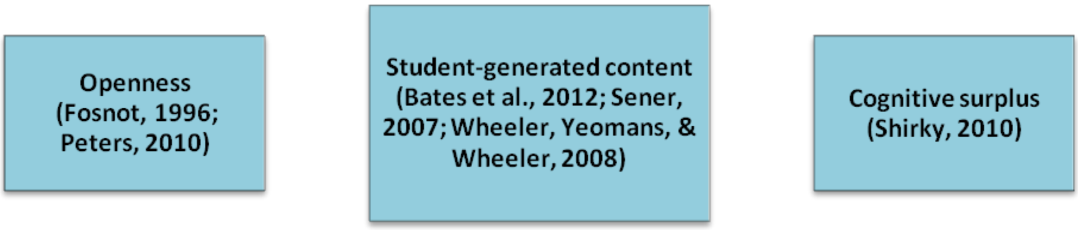


Figure 5.2: Phase One of Iteration 0 – Literature review map

5.2.1 Concept of openness in OER

In Chapter Two, the concept of openness is identified as a major theme of OER. Section 2.3 suggested the adoption of openness and OEP are keys to design principles of the proposed OER development model. In the educational sector, openness is associated with learning material, learning platforms and educational practices with institutions and individuals such as Open Learning, Open University, Open Practices, OER and more recently, Massive Open Online Courses (Peter & Deimann, 2013). In the context of open universities, it has been argued that openness is changing the way in which higher educational institutions operate and the way that people acquire knowledge. In addition, it has the potential to impact how people learn (McAndrew, Farrow, Law, & Elliot-Cirigottis, 2012). D'Antoni and Savage (2009) stated that 'openness is the breath of life for education and research. Resources created by educators and researchers should be open for anyone to use and reuse' (p. 138). In OER, openness is reflected in the way learning resources are used, reused and repurposed by learning content developers, in addition to the promise of openness to support the sustainability path of OER initiatives.

However, understanding openness for learners is a challenge that faces educators adopting OER and OEP in the learning process. For example, McAndrew (2010) argued that learners and teachers have difficulty in distinguishing between the different intellectual property licences for online learning resources. Therefore, in order to address the challenge of raising awareness of the value of openness, OER and OEP in higher educational institutions, the focus needs to be on creating opportunities for students and teachers to collaborate through OEP as a part of the learning process.

Peter and Deimann (2013) investigated four different historical eras (late middle ages, industrial revolution, modern era and post-modernism) of openness and emphasised that the concept of openness in education has many aspects, including technological, social, cultural and economic phenomenon that must be considered as important background information of openness. They stressed the risk of neglecting one of these aspects will have a negative effect on opening education and increasing opportunities of learning and teaching. Peter and Deimann (2013) also highlighted that history will enable researchers to understand and examine the meaning of openness in the context of education through communities that are the driving force of openness. The authors concluded that based on the original definition of openness that is witnessed in parts of the studied historical eras, it is a risk to assume that large learning communities are suitable for all types of learners.

Therefore, the proposed OER development model establishes communities of students and teachers to work on generating the OER in smaller communities such as study groups at the unit level. In addition, communities of teachers and students can be diverse in terms of their skills in using new technologies and the motives that drive teachers and students to create and share learning resources.

5.2.2 Technologies supporting openness in education

The rapid development in ICT led to significant improvement in different aspects of higher education, especially in the last three decades (Grabowski, 2009). At the top of technologies today, Web 2.0 services are forming main portals for activities in business, learning, research, social life and politics. This wide proliferation of ICT also supported the rapid development in learning technologies, such as multimedia learning resources, learning management systems, OER, digital text books and the recent MOOCs innovation. Among these learning technologies, the concept of openness has remained a driving force that supports the learning process and opens up opportunities for new educational technology interventions.

In the context of open learning, Peter and Deimann (2013) and Cheng (2013) discussed the emergence of open learning terminologies that have embraced different learning approaches and technological innovations through different eras of time, most importantly, with the advent of rapid advancement in technologies. The terminologies reflect the concept of openness as the driver of the learning process.

Table 5.1: Open learning models supported by ICT and openness

Open learning models	Definition of the model	ICT supporting each model	Examples	Literature
Open schooling	An institution is open in its processes for out of school groups, and emphasis on flexibility and democracy in schooling regardless of age, education, number of courses to enrol or content of study.	Radio in the 1930s, Television in the 1950s Process re-engineering in 2000's to automate the schooling systems	National Institute of Open Schooling (NIOS) India 1989 Open Access College (OAC) Australia	Haughey & Stewart (2009); Phillips (2006); Priyadarshini (2006, 2009); Sharma (2010); Smith (1996)
Open access	Public access to learning resources available on the internet from higher educational institutions.	Internet 1990s and open-source learning management systems (Moodle)	United Kingdom Open University 1969	McAndrew (2010); Kanwar, Kodhandaraman, & Umar (2010)
Open learning content	Framework of learning resources that permit activities of reusability including retain, reuse, revise, remix, and redistribute of content (Wiley, 2014).	Object Oriented Programming 1990s	Learning objects, learning objects standards, OpenContent, OER MIT-OCW 2002	Wiley, 1998; United Kingdom Open University (1969); Gourley & Lane (2009); D'Antoni & Savage (2009)
Open learning society	Learning and teaching in online social networks with large group of learners.	Ubiquitous computing Social networking and Web 2.0 in the 2000s	MOOCs OER University	Siemens (2005); Downes (2007); Mackintosh et al. (2011); Mason & Rennie (2008)

Table 5.1 shows different open learning models, highlighting the definition of each model and ICT that support each model. It also provides examples of each model and lists the associated literature review in the last column of the table.

Table 5.1 also shows how the combination of openness and ICT plays a vital role in supporting models of open learning, and how the development that happened over time reflects the transformation of learning by individuals who have the opportunity to access school regardless of their demographical aspect (as in open schooling and open access models) to learn in communities and large networks (as in open learning society model). This conclusion to learning in communities can be considered when designing a learning model that adopts openness and ICT as cornerstones of its conceptual framework.

Despite openness in higher education ranked number one in innovation, according to the NMC Horizon Report, and represented as the primary motivation in top innovating pedagogies in 2013 (Sharples et al., 2013), the role of educational institutions on embracing OEP by faculties and students can be considered a crucial step to realising the value of openness in learning and teaching. Hence, contributing with evidence-based research on the role of openness in education with the support of ICT can help institutions realise its benefits.

Therefore, to propose an OER development model through adapting OEP supported by ICT is an essential step, especially if it anticipates enhancing the learning process and sustaining OER in higher education. The following OEP were considered in the initial design principles of the proposed model:

- Raising awareness of the value of openness between participants in researching and accepting opening intellectual production.
- Integrating the OER development model in a real educational setting.
- Utilising existing online OER repositories in learning design and teaching practices to avoid duplication.

5.2.3 Student-generated content

The wide proliferation of Web 2.0 tools encouraged content creation through writing and media production, resulting in diversity of content and quality of online information

(Daugherty, Eastin, & Bright, 2008). The concept of Web 2.0 emerged in 2005 and was defined by O'Reilly as 'an active and open web architecture that enables users to interact and collaborate with each other in a social media dialogue as creators of user-generated content in online communities' (O'Reilly, 2005). Contrary to mainstream media, such as television, radio and printed press, Web 2.0 engaged media audiences to generate online content (Daugherty et al., 2008) and help create values for contributors and non-contributors (Shirky, 2010). User-generated content described how the general public produced digital content rather than paid professionals and shared it on the internet (Daugherty et al., 2008). User-generated content, also known as 'user-created content' and 'consumer-generated media' (Ochoa & Duval, 2008), is defined by OECD (2007b) as the content that is publicly available through social networking websites, reflecting creative and collaborative efforts of users created outside of professional routines and practices with intrinsic motives. User-generated content can be found in social networking website, blogs, wikis, video clips, commercial websites, reviews and software development. Importantly, user-generated content is described as a result of openness in online communities and open collaboration (Levine & Prietula, 2014), which is also described by Shirky (2010) as the cognitive surplus that has many promises to advance the development of sectors of human life. Therefore, a rigorous body of research is taking place concerning the impact of user-generated content on different aspects of human life. However, the position in this study is to show the impact of the content that can be generated collaboratively by students and teachers inside higher educational institutions on the learning and teaching processes, and the value that can be taken out of it.

Although user-generated content and Web 2.0 originated outside educational institutions, they proved to have significant impact on enhancing learning processes and learning outcome (Redecker, Ala-Mutka, Bacigalupo, Ferrari, & Punie, 2009). Learning environments have adopted the Web 2.0 in learning approaches where Web 2.0 tools help in facilitating active learning by providing students with the opportunity to participate in collective and collaborative learning activities through applications such as blogs, wikis, social networking sites, online games, online video sharing and immersive virtual environments (Huang, Hood, & Yoo, 2013).

Previous research investigated the use of Web 2.0 tools in educational environments and ways facilitate these tools within the learning and teaching processes (Gráinne et al., 2010; Franklin & Van Harmelen, 2007; Greenhow, Robelia, & Hughes, 2009). Among the approaches of integrating Web 2.0 tools, the user-generated content concept in the formal learning environment has focused on engaging learners in content generated activities. The purpose was to allow students the responsibility of generating content as part of their learning process. Such approaches are labelled ‘student-generated content’ (Sener, 2007), ‘learner-generated content’ (Pérez-Mateo et al., 2011) and ‘student as producer’ (Neary, 2010), which all refer to students generating different type of multimedia through their learning process, such as a project-based learning approach (Boettcher, 2006). Student-generated content can include projects, assignments, drafts of solutions, experiments, discussion forums content of the learning management system, student portfolios and student personalised references (Lee & McLoughlin, 2007). Student-generated content can also be a set of questions, as in the PeerWise application (Bates & Galloway, 2013). PeeWise is an example of student-generated content where students generate assessment questions as part of their learning process. The approach is found to support teaching and enhance learning process by engaging students in the construction and evaluation of multiple choice questions (Bates & Galloway, 2013; Denny et al., 2008). Student-generated content is becoming a dynamic area in learning and teaching, where students become producers of knowledge in the learning process rather than sole consumers. In 2014, student-generated content became a prominent teaching and learning trend in higher education (Johnson, Becker, Estrada, & Freeman, 2014).

A wide range of social networking tools such as Facebook, wikis, blogs and YouTube offer students the opportunity to share their ideas, celebrate their creativity and receive immediate feedback from fellow networkers (Wheeler, S., Yeomans, & Wheeler, D., 2008). Therefore, the learning design emerged to support student-generated content approaches and provide structured descriptions of learning approaches that can be adapted in similar learning environments. For example, Matthew, Glynis and Lynn (2011) presented a learning design for student-generated iVideo filmmaking that developed student skills in detailed reporting through using Web 2.0 tools to support dissemination of their videos and through YouTube, followed by receiving feedback from peers locally and internationally.

It can be concluded that theoretical benefits of adapting student-generated content as a part of the learning process included:

1. Engaging students in constructing their learning experience rather than being passive consumers (Mason & Rennie, 2008; Winn & Lockwood, 2013) where the final product becomes an output that serves them in building portfolios (Pérez-Mateo et al., 2011).

2. Developing their teamwork skills and contribute to their persistence and motivation to learn (Mason & Rennie, 2008; Sener, 2007).

3. Learning content that can be shared with future learners or become a reusable product that is beneficial for professional or societal further development (Pérez-Mateo et al., 2011).

However, to date there are only a few instances where integrating student-generated content that can be shared online as a part of the learning process in higher education (Bull, Thompson, Searson, Garofalo, Park, Young, & Lee, 2008; Greenhow et al., 2009; Huang et al., 2013). In addition, these authors who identified the benefits of student-generated content, also raised concerns about student-generated content in the learning process. For example, there is criticism about the quality of user-generated content and student-generated content (Pérez-Mateo et al., 2011). In addition, user-generated content in educational settings can be hard to locate, especially for the end user (Mason & Rennie, 2008; Sener, 2007).

In conclusion, in order to engage students in generating OER, it was important to develop a learning approach that integrates student-generated content as part of the study unit and adjusts the quality of the generated content during the development process. In addition, dissemination of student-generated content can be through the university's web presence by aggregating and sharing good examples of student works. Therefore, there is a need for integration the OER development model as a part of a study unit at the School of Computing, Engineering and Mathematics.

5.2.4 Cognitive surplus

Cognitive surplus was highlighted in Chapter Two. This section and its subsections provide in-depth exploration of the concept and implications for the OER development model proposed in this thesis. The cognitive surplus concept describes the abundance of online activities that people generate in their free time. The concept was coined by Shirky in 2010. Shirky is an American writer, consultant and teacher on the social and economic effects of internet technologies. He argued that tapping into the cognitive surplus can create a real value for others.

In his book 'The cognitive surplus: Creativity and generosity in a connected age', Shirky used the term 'cognitive surplus' to refer to the abundance of small contributions that people make collaboratively through using social networking software tools. As a result of crowded sourced activities tapping into the cognitive surplus, people come up with creative acts. Nowadays, the cognitive surplus is derived by social media applications such as YouTube, Facebook, Flicker and Twitter, which are reframing the way we use and spend our free time, from creative work to simple work. Technology in general and Web 2.0 tools in particular, have changed the way we use our free time, and turned many past consumers into producers. Shirky argued that ICT have transformed people from consuming their free time of watching TV to becoming a part of productive online communities of user-generated content. Shirky associated this collective human production with intrinsic motivation of knowledge-sharing, and argued that the cognitive surplus has the potential to change the world if applied to civic endeavours.

In the concept of the cognitive surplus, five factors can be concluded as essential to any cognitive surplus activity: ***time, technology, skills, collaboration and motive***. Tapping into the cognitive surplus is what Shirky described as creative acts that bring important value to oneself (personal), to a small community (communal), to the majority of people (public) and to both oneself and the whole world (civic). According to the cognitive surplus concept, contrary to the past when people spend their free time watching TV, nowadays they have the means and tools to utilise their free ***time*** with productive and important acts (Shirky, 2010). In addition, findings from previous research show that youth spend a considerable portion of their daily life interacting through social media (Ahn, 2011). Hence, free time is being used differently with the availability of new ***technology*** represented by the internet and Web 2.0 tools.

Access to the internet connects people with each other as they produce, learn, connect, share and shop online. In addition, Web 2.0 tools that facilitated user-generated content, such as wikis, blogs, YouTube and social networking websites have freed people from becoming passive consumers of content to active producers, and provided them with the opportunity to share with everyone in the world. The use of Web 2.0 tools has facilitated generations of learning resources and they are less likely to leave learners in the same profession for their entire life (Kozinska et al., 2010). People utilising the internet have developed certain ***skills*** in using social networking software tools, and are able to create new opportunities for other internet users, as discussed in early Section 5.2.4 referring to user-generated content.

Cognitive surplus also appears in other activities, such as technically skilled people contributing to the development of open-source software that can be also described as user-generated content. The open-source software is computer software that is freely used, modified and distributed with its source code and compiled form. Open-source software is usually developed ***collaboratively*** by many people and distributed under open-source licensing that defines the terms of reusability and distribution (Laurent, 2004).

Examples of cognitive surplus included collaborative development of a particular service. Ushahidi is a software service developed for reporting violence acts in the local community. It is open-source and allows people in crisis areas to report on local events to a central server of the service website through sending text message from their mobile phones and other submission forms. Reports submitted to Ushahidi are analysed and aggregated in ways that are useful to first responders and others interested in providing help (Shirky, 2010). Hence, people acting collaboratively on reporting violence acts is makes the final reports of Ushahidi worthwhile and target areas to become safer places for people to live in. In this example, Shirky argued that the collaborative work of the community and the sense of belonging played a vital role in obtaining value of the cognitive surplus.

Accordingly, Shirky stated that most of what drives people to create and share online are usually intrinsic ***motives*** rather than extrinsic ones, as he based much of the arguments on seminal work of the ‘crowding out theory’ by Deci (1974). The crowding out theory explains the effects of rewards for people’s intrinsic and extrinsic motives, adding that by providing external rewards for doing a cognitive activity, people would not be so eager to do it if the external rewards were removed. Therefore, the reward is given more attention than the actual activity. In his research findings, Deci concluded that increasing extrinsic motivations can actually decrease intrinsic ones (Deci, 1974).

In a research study that took place at the United States Military Academy at West Point, New York conducted on 11,320 cadets in nine entering classes, the survey showed that people with strong motives are more engaged in their activities and more likely to perform with success (Wrzesniewski & Schwartz, 2014). In an educational context, Vansteenkiste, Lens and Deci (2006) presented an argument based on previous experiments that showed that emphasising the intrinsic value of learning activities for students ‘produces deeper engagement in learning activities, better conceptual learning and higher persistence’ (p. 19) than motivating individuals through extrinsic rewards. In addition, the intrinsic motives of acting autonomously, feelings of competency, being connected and sharing are identified as drivers of people’s performance in most cognitive activities (Deci & Flaste, 1996; Shirky, 2010), therefore, focusing on intrinsic motives need to be considered when designing learning interventions that expose learners to the wider community.

Wikipedia, the online encyclopaedia, is an example of cognitive surplus today. In Wikipedia, individuals contribute their time and knowledge to an online open-content encyclopaedia (technology) by revising previously published articles (skills). Forte and Bruckman (2008) showed that Wikipedia contributors are driven and motivated to create and share knowledge by a sense of credibility and authorship that mark their contributions in the Wikipedia community (collaboration). In addition, it has been argued that Wikipedians are rewarded with satisfaction factors, including subjective task value, commitment and procedural justice in order to continue editing Wikipedia content (motives) (Lai & Yang, 2014).

However, the value of each activity can vary from simple to most important and from personal to civic acts. For instance, uploading photographs with misspell captions such as in the Lolcat website (www.icanhas.cheezburger.com) does not benefit the creation of knowledge, however, it is an example of the free time that people have in their lives that can be tapped into. On the other hand, building open-source software that has real public value is important and significantly contributes to improving people’s lives, such as the Apache open-source computer operating system (Shirky, 2010).

In this study, cognitive surplus is discussed in the context of higher education, as few educational technology researchers have referred to this concept for learning and teaching (Bruff, 2010; Bull, 2008; Gibson, 2008). Shirky strongly justified that cognitive surplus has created important opportunities that can change people’s life. However, there still a need to tap into it in the educational context.

5.2.4.1 Tapping into cognitive surplus

This section continues to explore the concept of cognitive surplus. Tapping into cognitive surplus can have one of four different values, as identified by Shirky: (i) personal; (ii) communal; (iii) public; or (iv) civic. Table 5.2 summarises these values and provides examples from voluntary participation that harnessed with technology. The last two columns in Table 5.2 consist of examples from higher education and TELE on each value.

Table 5.2 provides practical examples of software tools and learning interventions that tap into cognitive surplus in higher education. However, in the last example of learning activities that has civic value, the term ‘student-generated learning resources’ is used to describe one of the contributions of the research study of this thesis.

Table 5.2: Tapping into the cognitive surplus in higher education and in technology enhanced learning environments

Values of tapping into cognitive surplus	Description of the activity	Example from social media activities	Examples from higher education	Examples from technology enhanced learning environments
Personal	Participants and beneficiaries are acting individually but get personal value out of other's presence. Participants derive value from the act of sharing itself, anyone can participate and the benefits are usually personal.	icanhas.cheezburger.com/ (photos with misspelt captions)	Peer review Students projects and assignments	Socrative Microsoft PowerPoint presentations
Communal	Takes place inside a group of collaborators, where mutual sharing derives much of the value for participants. These activities have little or no value for non-participants.	Meetup.com (women with depression meet online and share their stories) couchSurfing.com (people offer to accommodate each other in their homes without any charge for a holiday or short stay) pickuppal.com (transportation site where people pick up each other to places such as work or universities based on agreed charge) researchgate.net (a social networking site for researchers to share, connect and publish scientific papers) Online fan communities	Schools conferences, exhibitions and seminars	Online discussion forums
Public	Open form of participation where anyone can participate, and everyone can benefit even non-participants.	Open source software projects (e.g. Apache project) Wikipedia	Libraries	Moodle learning management system OER MOOCs
Civic	Open to anyone to participate and it has benefit for the whole society, and the participants has explicit goal of improving society.	Ushahidi (online service that allows people in crisis areas to report on local conditions using mobile phones)	Scientific research	Student-generated learning resources as OER

To provide civic value, Shirky emphasised that it must create a value for itself and the whole community. In this thesis, student-generated learning resources shared as OER are suggested to have civic value where students benefit from generating learning resources and the community benefit from the dissemination of these learning resources as OER. Even though they are harder to create, Shirky called for more initiation of civic and public values where the whole community can benefit from them more than personal and communal, as he argued that there is a great opportunity to build systems, platforms and tools that enable and encourage public and civic sharing for a wider benefit. However, these opportunities are not easy to achieve and require commitment, self-governing, ignoring distractions and hard work by the participants.

In Table 5.2, OER are identified as creative acts that people with knowledge create for the whole community. Mainly, academics and experts with knowledge participate in building OER and creating public value that can be shared by all types of learners. However, to create OER as a civic value, explicit goals, committed participation and self-governing by members are necessary. Establishing such goals can be possible in a well established community, as opposed to an open community where people are not obligated to maintain memberships. Higher educational institutions can be a suitable environment for such communities where formal membership is maintained by all members. Hence, OER initiatives such as MIT-OCW and OpenLearn of the Open University UK are among the pioneers and examples of successful OER projects. These projects are known to be sustainable as funding continues. However, if funding ceases, questions can be raised about whether academics will continue to share their intellectual property. Therefore, harnessing the intrinsic motives for creating and sharing OER in higher educational institutions can lead to a civic value that can be enjoyed by its members and other learners from outside the institution. Benefits can be released through OEP and through building communities of practice around OER inside higher educational institutions. Shirky (2010) concluded that accuracy, transparency and sharing in scholarly work gives greater access to collective knowledge so everyone gains access to any success and failure (Shirky, 2010).

This thesis presents a new OER development model that engages students as content developers and their teachers as facilitators in generating learning resources. While making this model part of a teaching unit, social benefits can be realised for students and teachers in collaborative knowledge construction and joint authorship of OER. The model can lead to further benefits, including better learning outcomes, learning engagements, personalised learning, acting autonomously, feeling of competency, being connected with a sense of belonging, improving the quality of student projects and showing evidence of graduate attributes.

5.2.4.2 Implications of cognitive surplus for the OER development model

In formal education, cognitive surplus has been explored by some educators in order to find opportunities to improve learning and teaching activities (Bull et al., 2008; Gibson, 2008). Bull and others (2008) argued that there is a need to connect informal online activities that students are engaged in with social networking websites and formal learning that students receive in schools and universities.

Among the endeavours that capitalise on cognitive surplus in learning and teaching while connecting formal and informal learning is the relatively recent online phenomenon, Massive Online Open Course (MOOC). The term ‘MOOC’ was first introduced in 2008 by Cormier to describe Siemens and Downes’ ‘Connectivism and Connective Knowledge’ course (Yuan & Powell, 2013). The connectivism learning theory described a model of learning in the network environment in the digital era (Siemens, 2005) with key principles including autonomy, connectedness, diversity and openness (Tschofen & Mackness, 2012). A MOOC is described as an online course that provides interactive user platforms to support interactions between students, professors, and teaching team. Providers of MOOCs emphasise open-access features, such as open licensing of content, structure and learning goals, to promote the reuse and remixing of resources. Some later MOOCs use closed licences for their course materials while maintaining free access for students. The *New York Times* acknowledged 2012 as ‘The year of the MOOC’ because several initiatives were launched, such as Coursera, Udacity and edX, offering online courses from universities around the world (Pappano, 2012).

Another example of harnessing cognitive surplus in educational settings is The Global Challenge Award initiative (Bull, 2008a). The initiative is an online science and engineering program for young students working collaboratively with international counterparts to address global climate change problems in finding solutions with creative ideas that have significant impact on global challenges through online learning environments (Bull, 2008; Digital Media & Learning Competition, 2009; Global Challenge, 2014). The program engaged students in the online learning environment, through using game-based learning, simulation and online learning resources to work on a solution to mitigate global warming and renewable energy. The initiative started in 2005 in partnership with the University of

Vermont and collaboration with the National Science Foundation, funded by the MacArthur Foundation Digital Media and Learning program and other foundations and corporations (Global Challenge, 2014). However, it is adopted worldwide, for example, the Institute of Engineering and Technology Global Challenge competition UK for students and young professionals between the ages of 18 to 35 working in teams to address a real world engineering challenge (Global Challenge, 2015). Further initiatives include the MIT IDEAS Global Challenge US which started in 2011 and currently invites students, faculty, staff, alumni and their collaborators to address community development challenges through innovation and collaboration in communities around the world (MIT IDEAS Global Challenge, 2015). In Australia, the initiative is also adopted by the University of Wollongong through the global challenges program (UOW Global Challenges Program, 2015).

Both examples provide ways of connecting formal and informal learning by offering learning experiences that tap into learners' skills in using new technologies and their capabilities of engaging in formal online learning communities. Therefore, the area of student-generated content that results in cognitive surplus needs to be repurposed effectively.

Cognitive surplus in higher educational institutions can be found by students on a particular course during an academic semester. In learning assessment approaches, students usually spend hours on solving problems, generating projects and writing essays as part of their learning assessment activities. However, if considerable time that students spend on accomplishing the required assignments is treated with importance, then significant value for learners and the educational institution can be derived out of it. Fundamentally, student assignments can ultimately be shared by other learners as OER. In this study, the focus is on tapping into student-generated content that is taking place through the project-based learning approach and repurpose projects to be developed as learning resources and eventually shared as OER.

In Chapter One, Section 1.3 highlighted the issue for cognitive surplus of student-generated content, and emphasised that few research studies have tapped into student projects in a pedagogically informed approach. In the SCEM at WSU, the project-based learning approach is being adopted by a wide range of teaching units. In a project-based learning approach, students work collaboratively on solving challenging problems that are open-ended, curriculum-based and often interdisciplinary based on their prior knowledge by gathering information from different resources and synthesising, analysing and deriving knowledge from it (Chandrasekaran, Stojcevski, Littlefair, & Joordens, 2012). In many cases at the SCEM, a project developed by a student or group of students gets evaluated by one teacher. The matter that makes the project seen by a limited group of people is where it could has better potential if shared among a larger group. Even though some projects receive attention at the end of the academic semester, the majority of student projects are usually archived or kept for a short term on the teacher's bookshelves and eventually discarded. Therefore, tapping into these projects in a pedagogically informed approach can help to realise the value of cognitive surplus through repurposing student projects in the OER development process.

Hence, investigating the abundance of student-generated content in the learning environment has urged the call to tap into this content by repurposing student works towards building learning resources. It also responds to the call on capitalising cognitive surplus in higher educational institutions. In addition, the utilisation of student-generated content was a response to the lack of participation in generating OER by academics in higher education and the need to find new contributors to the OER development process. Placing students in the role of content generators was the starting point of the OER development model and the focus of the research to address the OER challenges identified in Chapter Three.

5.3 Phase Two

The role of the theory in DBR aims at supporting the initial design principles informed by theoretical framework. Phase Two of DBR involves the development of an initial design solution based on the literature review investigated in Phase One. Therefore, Phase Two of Iteration 0 summarised the literature review into the theoretical framework of the OER development model. This theoretical framework showed the role of openness in education, lessons that can be learned from previous OER development models, student-generated content as the foci of investigation in the learning environment and the concept of cognitive surplus that described people utilising new technologies, in particular, Web 2.0 tools for generating online content and creating generous opportunities for each other that maintain important benefits.

The following principles summarised the initial design principles of the OER development model:

Principle One: Six elements of the OER model

The principle is based on six elements of OER projects that were summarised following review of existing OER projects (Chapter Two). These elements were found to be essential for proposing a new OER development model. The elements include:

1. Learning material: The educational content of the resources which can be of different multimedia and usually forms part of the teaching course in the proposed model.

2. ICT: Including different ICT that support the development and publication of OER, such as content authoring software tools, learning management systems and content repositories.

3. Stakeholders: Developers and users of OER, such as students and teachers.

4. Institutions: Higher educational institutions are suitable environments as they contain numerous stakeholders (Element 3).

5. Learning design: Structuring the learning resources and organisation of the educational content and supporting learning activities.

6. Intellectual property: Open publishing licences (Creative Commons) that maintain the intellectual property of learning resources.

Principle Two: Understanding the feasible scope of the OER project

Principle Two is based on lessons learnt from the cognitive surplus (Shirky, 2010) and the discontinued OER project, as discussed by Friesen (2009) and presented Chapter Three. To fully understand the scope of an OER project, stakeholders need to consider the following guidelines:

1. When starting a small OER project in a study unit, it is necessary to understand how it will work for one group as each learning environment is different, students differ in their characteristics and their skills vary. Teachers' experiences in developing learning resources can be also diverse and discipline-specific. In addition, the learning environment that uses ICT as enabler of the learning process is also different from traditional classroom settings. Hence, working with one group appears

straightforward, but there are many details that need to be considered and tools that need to be tailored to ensure properly utilisation of the learning process.

2. Adopting OEP can start with asking students to reuse existing OER and make their own learning resources open for other learners.

Principle Three: Student-generated content becomes OER

Principle Three is based on an existing problem of the cognitive surplus inside classrooms, as discussed in Section 5.2.3 and Section 5.2.4.

To integrate the OER model into a study unit at a higher educational institution, the unit must have a project component as part of the unit assessment. In project-based learning, students work collaboratively on solving genuine problems as part of the curriculum assessment, by acting autonomously on how to find resources, evaluate them and use them to present new knowledge as solutions of the problems (Solomon, 2003).

This learning approach is used widely among teaching units of computer science and IT in higher educational institutions, as these courses are usually practical units with practical components (Pucher & Lehner, 2011). Referring to an existing problem in Section 5.3.4, many of these projects became obsolete at the end of the academic semester and opportunities for tapping into cognitive surplus were limited. One way to tap into student projects was to repurpose cognitive surplus towards building learning resources to be shared via OER. Therefore, for the OER development model to be integrated into a study unit, the unit must have a project requirement as part of the unit assessment.

The above design principles were used to provide an initial OER development design model and support the integration of the model in real educational settings. Phase Three presents these principles in practice and in further detail. The initial OER development model is depicted in Figure 5.3 and consists of three stages, as follows:

1. *Building learning resources*: Students enrolled in a study unit with project-based learning of its learning approaches build the learning resources using content authoring software tools.

2. *Evaluating learning resources*: As teachers become part of the development process of the learning resources, their role is based on facilitating students' work and providing feedback on the development process of the learning resources.

3. *Publishing learning resources as OER*: At this stage, the learning resources are published online openly.

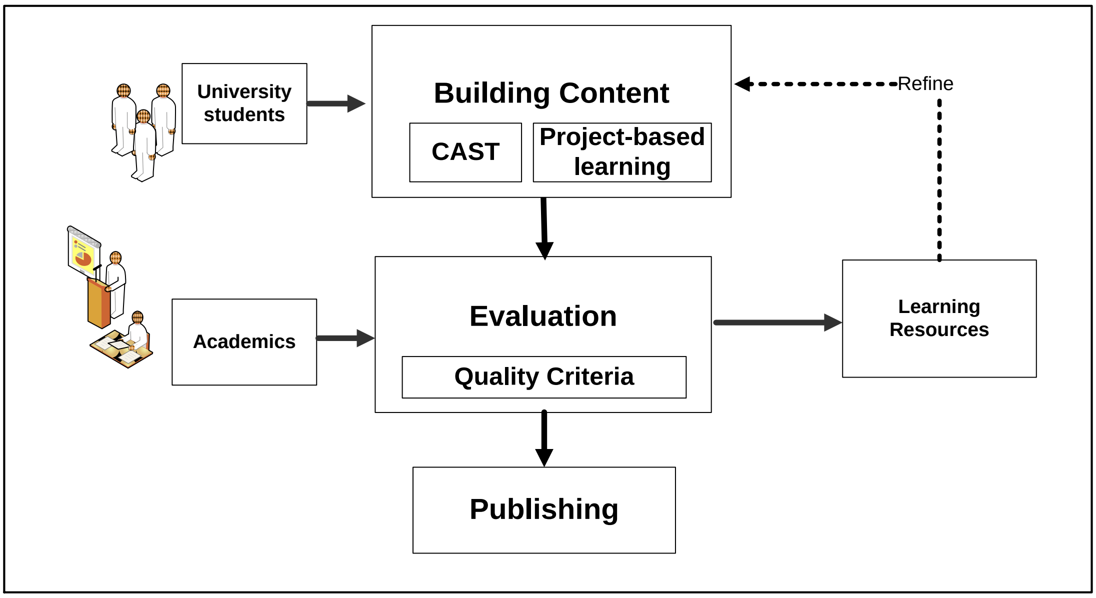


Figure 5.3: Initial design of the OER development model

The initial OER development model aimed at establishing new OEP in real life educational settings where students worked on generating learning resources that can be shared as OER. Phase Three presents the integration of the initial model in one study unit at the SCEM.

5.4 Phase Three

As introduced in Section 4.7, in DBR, Phase Three focused on the implementation and evaluation of the proposed solution through several iterative cycles that took place in an educational environment. The implementation of the solution in real-life settings was based on the recommendations from Phase One and Phase Two of each iteration, which included the developed literature review which showed the important role of openness in learning and teaching, benefits that can be derived from student-generated content and implications of cognitive surplus in higher education. The outcome of Phase Three helped with improving the initial design principle of the proposed OER development model proposed in Phase Two. In Iteration 0, Phase Three consisted of one cycle.

5.4.1 Cycle 1 of Iteration 0: Description

Cycle 1 of Iteration 0 took place during the academic semester August to November 2012. The participants were students enrolled in the ‘Introduction to IT’ unit (300134) a unit offered online from the SCEM at WSU.

> *The ‘Introduction to IT’ is an introductory unit, offered for all students at the university as an elective unit from the School of Computing, Engineering and Mathematics. The unit carries 10 credit points, and aims at giving students an insight into the use of computers and their impact on society. After completing this unit, students are expected to gain a basic understanding of the use of computers, and skills to use popular application software, including word processors, spreadsheets, database packages, and internet tools and services.* (2012)

At WSU, one academic semester is 14 weeks. Enrolled students in the ‘Introduction to IT’ unit were required to attend 12 tutorial classes, stage a presentation, complete a questionnaire and final examination, and submit a final portfolio that included a major activity. The major activity represented the task in which students generated the learning resources based on their previous knowledge in a study unit that they were currently studying or already studied at WSU. The project assignment was due on Week 13 of the semester. The ‘Introduction to IT’ unit aimed at giving students insight into the use and impact of computers on society. The learning objectives of the unit included giving students a basic understanding on the use of computers and developing their skills to use a set of software tools (Introduction to Information Technology, 2012).

Cycle 1 took place in the research where specific aims of the cycle were anticipated in order to assess the feasibility of the OER development model in the learning environment, as follows:

- Evaluating student projects by assessing the quality of the learning resources that can be shared as OERs.

- Assessing the readiness of teachers to support their students in the OER development process.

- Determining whether the selected teaching unit is adequate for growing the OER development model over the next iteration.

- Identifying the appropriate time to launch the survey, including the need for other data collection tools, such as interviewing the teaching staff.

At the end of Cycle 1, important outcomes and a set of modifications to be carried out to Phase Four were identified in order to reflect on the initial design principles and enhance the solution implementation. Documentations of the iteration were also completed in Phase Four.

5.4.2 Cycle 1 of Iteration 0: Participants

The identification of participants in the research was important to the design principles of the OER development model as the final set of principles needed to reflect on the characteristics of the learning environment. A total of 268 students were enrolled in the 'Introduction to IT' unit for the academic semester August to November 2012. Only 212 students submitted their projects through the virtual learning management system of WSU (vUWS).

Students came from different academic backgrounds, as the unit is offered for all university students. Figure 5.4 shows the distribution of participants among five schools at WSU. Figure 5.4 also indicates that students from SCEM, School of Science and Health and School of Business dominated attending the 'Introduction to IT' unit. Even though the focus of the research lay in the context of results from the starting stage (Iteration 0), it can be extended to the growing stage with students of similar academic backgrounds.

The unit coordinator had an important role as one of the participants in the research. In Cycle 1, highly experienced in educational technology, the unit coordinator provided a suitable collaboration with the researcher, and guidance for students in the development of the learning resources.

Figure 5.4 shows the distribution of the major groups in the unit according to school names. The 'Others' group represents students from WSU College and missing values.

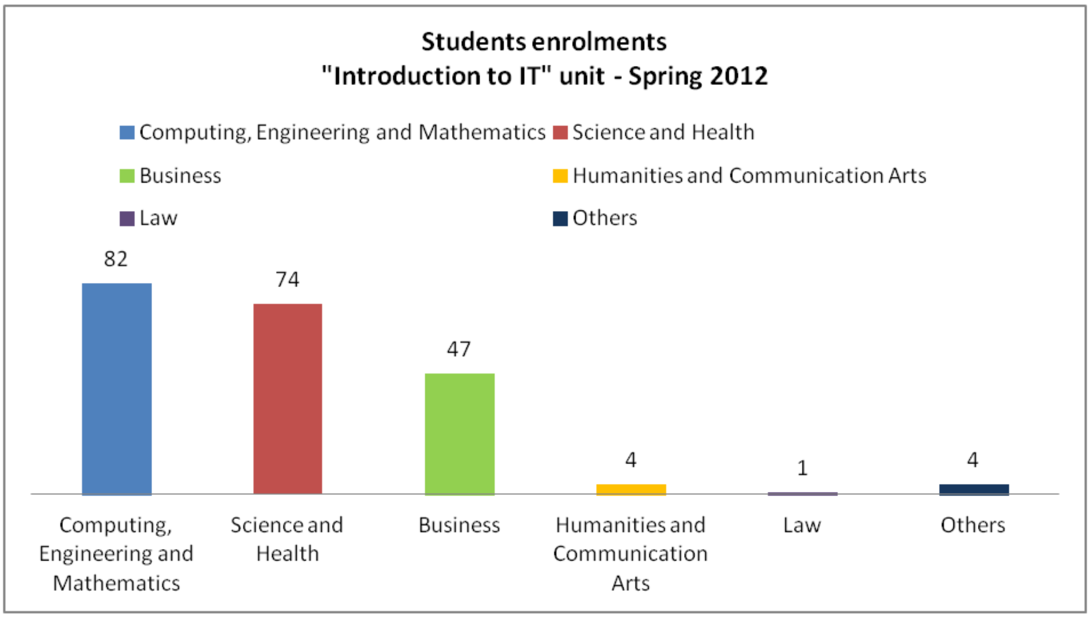


Figure 5.4: **Distribution of student enrolments of 'Introduction to IT' grouped by school name – Cycle 1**

5.4.3 Cycle 1 of Iteration 0: Data collection and analysis

Data collected in Cycle 1 were of two categories: (i) the first category consisting of data collected from student submitted projects; and (ii) the second category was data collected from student responses to an online survey. The following subsections provide more details on data collected from each category.

5.4.3.1 Students projects

Two hundred and twelve students completed the unit and submitted their projects (learning resources). Table 5.3 shows the mean and standard deviation of students according to their schools.

The weight of the project was 15% of the total mark of the unit. In Cycle 1, 96% of students were from the SCEM, School of Science and Health and School of Business. Interestingly, students from School of Science and Health were better in developing learning resources when comparing the scores achieved by all students.

Table 5.3 Descriptive statistics of student marks grouped by school names – Cycle 1

School name	Number of projects	Percentage	Mean*	Standard deviation
Computing, Engineering and Mathematics	82	39%	9.12	1.69
Science and Health	74	35%	9.34	1.21
Business	47	22%	9.26	1.86
Humanities and Communication Arts	4	2%	8.74	2.78
WSU College	2	1%	7.88	1.80
Law	1	0%	9.75	-
Unknown	2	1%	8.40	0

*Project weight = 15 marks

The projects were assessed based on the following criteria:

1. *Interest and usefulness:* Learning content gets the attention of learners and help teaching them.

2. *Product:* Final product presentable and can be used by other learners.

3. *Design:* Design of the presentation and layout whether the material is text, graphics, audio, video or audio-visual.

4. *Multimedia:* Appropriate use of different media in a learning content.

5. *Interactivity:* Learning content engages the learner and provides proper feedback on user's actions or utterances.

Students were given the choice of using one of the content authoring software tools from a list of tools in the unit learning guide. The list was recommended by the unit coordinator and included tools such as Microsoft PowerPoint, YouTube, Interactive PDFs, Prezi, wikis, Mobile Applications and iBook Author. Students also had the option to use any other tool of their choice. The reason for this flexibility was to give them the opportunity to work with the tools they are most confident and familiar with. However, students did not receive any training on using the tools, because it was assumed that they knew how to use them, however, they were provided with online links to tutorials of these tool, which they could use to teach themselves.

The tendency for students to use tools they are most confident with appeared among the high number of projects developed through using Microsoft PowerPoint. A total of 130 (61%) projects of interactive learning resources were created using Microsoft PowerPoint and scored an average mark of 9.18 and standard deviation of 1.15. Another 20 content-based (non-interactive) learning resources were created through using Microsoft PowerPoint and scored an average of 6.43 and standard deviation 1.17. The reset of learning resources created using different content authoring software tools included Apple iBook Author, narrations, mobile applications development, YouTube instructional videos, simulations and HTML tools. This set of learning resources consisted of 59 projects (29%) and scored an average mark of 9.99 and a standard deviation of 1.26.

The statistics show better performance for student projects that were created using different content authoring software tools other than Microsoft PowerPoint. Table 5.4 shows the mean scores for each group of projects categorised based on the software authoring tool used by students to generate the learning resource.

Table 5.4: Descriptive statistics of student marks grouped by content authoring software tools – Cycle 1

Content Authoring Software Tools	Freq. of use	Percentage	Mean*	STD
Apple iBook Author	3	1%	11.45	0.90
Narration tools (Adobe Articulate, BrainShark, Camtasia)	22	10%	10.06	0.73
Mobile Applications Development	6	3%	10.4	1.29
Interactive Microsoft PowerPoint, Adobe PDF and Prezi	130	61%	9.18	1.15
Content based Microsoft PowerPoint, Adobe PDF files and Microsoft Word documents	20	9%	6.43	1.17
YouTube Instructional Videos and Quiz	14	7%	10.61	2.07
Simulation tools (Adobe Flash, iSpring)	9	4%	10.15	0.90
HTML format files	5	2%	10.05	0.64
Others	3	1%	7.20	1.82

*Project weight = 15 marks

This is a preliminary indication for this part of the study and shows that students prefer working with what is available on their computer systems and what they have experience with, such as Microsoft PowerPoint. Students using tools other than Microsoft PowerPoint (29%) were able to achieve better results as they scored an average of 9.99 compared to the average of 9.18 out of 15.

The results indicated that student performance on embedding multimedia and learning resources interactivity within the learning resources were lower than the other criteria (interest and usefulness, product and design) as reflected in Figure 5.5.

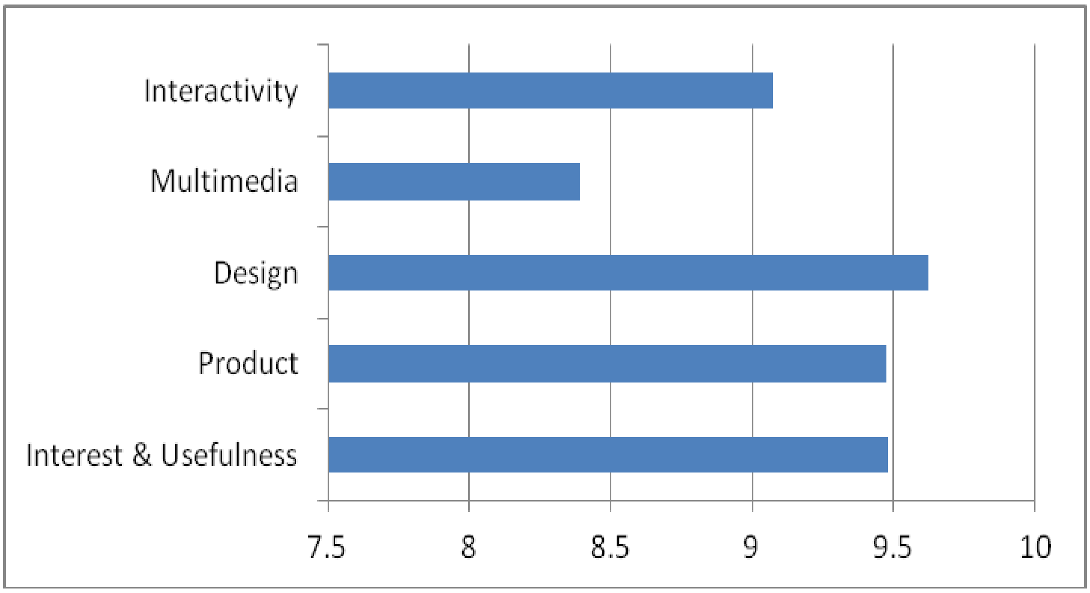


Figure 5.5: Means of evaluation criteria for all projects marks – Cycle 1 (project weight = 15 marks)

Therefore, shortage in the use of multimedia and interactivity of the learning resources required students to be provided with technical scaffolding over the next cycle of the research. In addition, none of the students used wikis or blogs, therefore, was an urgent call to introduce these tools for students because they are powerful options for generating learning resources.

5.4.3.2 Online survey – Student experience in generating online content

To help understand student characteristics related to generating learning resources, an online survey was launched at the mid of the semester on Week 7. The primary aim of the survey was to collect data about student experiences in using content authoring software tools, user-generated content and student-generated content. Data analysis from the survey was used to address the research question:

Primary question 1

Does involving students in generating learning resources provide a sustainable mechanism for developing quality OER?

And its sub-questions

1. Does previous experience with content authoring software tools affect the quality of student-generated learning resources? If so, what types of content authoring software tools provide better quality student-generated learning resources?

2. Does previous experience with user-generated content affect the quality of student-generated learning resources? If so, what types of user-generated content do university students create in their daily life for non-educational purposes?

Invitations to the online survey were sent through vUWS, and participation was voluntary. The response rate for the survey was 67.5% (n=181). Responses were gleaned from partially completed responses to become 163 completed responses, including 150 participants in the age group 18-24 years. Undergraduate students were mostly 18-24 years old. In 2012, this age group represented 49% of undergraduate students in Australian universities (Australian Government Department of Education, 2013). One hundred and twenty-seven students submitted both tasks, that is, the survey and their projects. The undergraduate learning environment was selected to be explored during the research of this thesis mainly for its abundance of student-generated content in these environments, as identified earlier in Phase One.

The survey consisted of five parts: (i) demographics; (ii) general experience with internet technology; (iii) student skills in using content authoring software tools; (iv) experience with user-generated content; and (v) experience with student-generated content. Sections 1-5 describe the sample of the participants:

1. *Demographics*

In the study sample of 150 participants in the 18-24 age group, gender distribution was 70.2% (n=105) male and 29.8% (n=43) female. The majority of students, 94% (n=141) were Australian residents and 6% (n=9) were overseas students.

2. *General experience with internet technology*

The survey showed that 50.7% (n=76) of students described themselves having strong competency in using technology, and the remainder 47.3% (n=71) described themselves with average competency. Students were asked about their Web presence in content generation websites by asking them if they have their own YouTube channel, art collection, Weblog, website, wiki or others: 87% (n=131) said they have one of the mentioned. In terms of the number of hours students spend on the internet, 71.4% said they spend more than four hours each day with an average for all participants of five hours and 53 minutes.

Students were also asked about their familiarity with seven general terms related to OER. They showed a considerable level of awareness of ‘Creative Commons’ and ranked their familiarity with the term OER in the middle. Students ranked ‘Online Copyright’ issues, ‘Creative Commons’ and ‘Open Source Software’ as the top three terminologies they are familiar with. ‘Open Educational Resources’ and ‘Open Learn’ came fourth and fifth. At the bottom, students listed MIT-OCW, MOOC and Open Access Journals as terms they are least familiar with.

3. *Student skills in using content authoring software tools*

The term ‘Authoring Tools’ is common in educational technology and e-learning environments. Although there are many definitions of the term that can be found from different resources, it is commonly known that authoring tools are software packages designed to help in generating and publishing hypermedia content. In this part of the survey, students were asked to assess their skills level in using content authoring software tools on a Likert scale of 10 points. The tools were arranged randomly in the survey, however, they were grouped into two types: (i) common tools (Windows Movie Maker, Microsoft FrontPage, Microsoft PowerPoint, Microsoft Publisher, Microsoft Word and Paint.NET;) and (ii) advanced tools (Adobe Photoshop, Audacity, Adobe Flash, iBook Author, iMovie and Others). Students left the field blank for tools they are not familiar with.

The mean of students' skills in using all common tools was 6.54 (SD 1.68), and using all advanced tools the mean was 4.27 (SD 1.78). Table 5.5 represents student responses on using content authorising software tools in both categories.

Table 5.5: Descriptive statistics of student skill levels of using content authoring software tools – Cycle 1

Advanced Tools	Mean*	Median	Std Dev.	Common Tools	Mean*	Median	Std Dev.
Adobe Photoshop	4.92	5	2.54	Microsoft Word	8.84	9	1.37
Audacity	3.88	3	2.46	Paint.NET	6.89	7	2.73
Adobe Flash	4.66	4	2.47	Microsoft PowerPoint	7.97	8	1.69
iBook Author	2.52	2	2.03	Windows Movie Maker	5.72	5	2.85
iMovie	3.69	2.5	2.84	Microsoft Publisher	5.47	5	2.71
Others	5.94	6	3.08	Microsoft FrontPage	4.34	4	2.75

*Rating scale = 1 (Never used) to 10 (professional user)

A subset of participating students (n=71) reported having varying skills levels in using another 43 different tools that were not listed in the survey; the mean was 5.94 (SD 3.08). Most of the tools were grouped into four main categories including:

1. Reporting and statistical applications
2. Programming and Web design applications
3. Music and movie applications
4. Drawing and graphic design applications

Students reported other tools that were not categorised as system design, interactive games, eLearning authoring tools and map design.

By looking at student responses on competency and skill in using common and advanced content authoring software tools, and correlating their responses to their marks in the project of developing learning resource, the results showed that the more skilled the student is in using advanced content authoring tools, the better the quality of generated learning resources they produce. As responses to this part of the survey were scale valued, the average response has been calculated for each group of tools on a scale of 10 stars, where 10 represents high skill and 1 represents no skill. Students' mean response for their skill levels on using common content authoring software tools was 5.7, and they showed lower skill levels on using advanced tools, the mean was 3.

For both categories of tools (common and advanced content authoring software tools), the means of skill levels of each group were set as thresholds (mean of common tools = 6.7; mean of advanced tools = 4.3). A threshold for each category was used to compare student marks in the projects for each category, that is, marks of those students reporting higher skills in using common content authoring tools were compared with those reporting lower skills in using same tool. A statistical analysis was also made to compare student marks in the advanced tools category. Table 5.6 represents the comparison among the two categories of tools.

Table 5.6: Measures of central tendency of student marks in correlation to their skill levels in using content authoring software tools – Cycle 1

Tools (n=127) Total score = 15	Mean*	Count	Percentage	STD	Median	Min	Max
Common Tools (threshold = 6.7)							
Less than threshold	9.61	61	48%	1.57	9.6	4.5	15
Above threshold	9.41	66	52%	1.55	9.6	3	12.3
Advanced tools (threshold = 4.3) 3 missing values							
Less than threshold	9.28	67	55%	1.78	9.6	3	15
Above threshold	9.85	55	45%	1.24	9.75	6.9	14.4
All tools (threshold = 5.8)							
Less than threshold	9.45	64	50.4%	1.85	9.6	3	15
Above threshold	9.56	63	49.6%	1.20	9.6	6	12.3

*Project weight = 15 marks

From Table 5.6, means of groups of student marks above the threshold appear to be better in the advanced tools group, in addition to achieving minimum and maximum marks higher than the other group. In other words, students who said they are skilled in using advanced content authoring software tools were able to generated better quality learning resources.

However, the correlation analysis based on Pearson product-moment correlation coefficient (PPMCC) determinant (r2) between paired scale variables 'students skills in using content authoring software tools' and their 'marks' in generating learning resources was 0.03 for common tools, 0.13 for advanced tools and 0.08 for all tools. Therefore, there was a small percentage of better student marks that can be related to having advanced skills in using content authoring software tools.

Thus, in addressing the research sub-question:

1.1 Does previous experience with content authoring software tools affect the quality of student-generated learning resources? If so, what types of content authoring software tools provide better quality student-generated learning resources?

It can be stated that further data collection of student experiences in using content authoring software tools can help support the 13% relation to student marks. Additionally, students can be provided with further information of other content authoring software tools that can be used to generate learning resource through the learning management system where they can use these new tools to generate quality learning resources.

4. Experience with user-generated content

In this part of the survey, students were asked about their experience with user-generated content. In this online survey, the term 'user-generated content' was referred to as 'using information and communication technology tools for non-educational purposes' (Appendix D). Students were asked about the frequency of completing 19 online activities in their daily life. Activities were listed in Likert scale questions and responses range from 4 = Daily, 3 = Very Often, 2 = Occasionally and 1 = Neve'. Means of 2.5 indicated frequent contribution of user-generated content for a particular activity.

This section of the survey helped to address the research sub-question:

1.2 Does previous experience with user-generated content affect the quality of student-generated learning resources? If so, what types of user-generated content do university students create in their daily life for non-educational purposes?

The correlation analysis using PPMCC between the paired scale variables is used to provide initial answer to the above research question. The data analysis showed a weak linear positive relation between student responses to all types of ‘user-generated activities’ and their achieved marks where the determinant (r2) was 0.18. This relationship, although a weak one, can contribute to answer the related research question by stating that the capacity of student on generating good quality of learning resources can be partially related to their previous experience with user-generated content. However collecting further data could support or decline this relationship.

Importantly, if a relation does exist, what types of user-generated content affect this relationship among all activities mentioned in the survey question? In order to understand the structure of student responses to this part of the survey, the existence of categories among user-generated content activities in the survey question were explored by means of exploratory factor analysis. Factor analysis is a multivariate statistical approach that intends to reduce the complexity in a set of data. There are two types of factor analysis: (i) exploratory factor analysis (EFA); and (ii) confirmatory factor analysis (CFA). In EFA, the researcher usually has no expectation of the number or nature of variables that can be formed from a set of data. On the other hand, in CFA, the researcher has preliminary theory and assumptions of the number of factors that will be formed (Williams, Brown, & Onsman, 2012). EFA was employed on the data set of the sample of study for this part of the survey of 150 responses. The analysis was performed by means of principal component analysis (PCA) with Varimax rotation. The procedure has also been guided by the work of Williams et al. (2012), and the software package used was IBM Statistical Package for Social Sciences (SPSS) to help with undertaking EFA. The steps were as following:

1. ***Data preparation:*** Starting with cleaning data from partially completed responses, 150 complete responses for this part of the survey were obtained. Responses were arranged into a readable format by converting the Likert scale into an ordinal format. The Likert scale values in the question were converted as following: 4 = Daily, 3 = Very Often, 2 = Occasionally and 1 = Never.

2. ***Suitability of data to factor analysis:*** Williams et al. (2012) pointed out that four tests should be performed to assess suitability of the data to factor analysis:

    i) *Sample size:* Larger sample sizes make a reliable correlation between the measured variable, thus can help to discern sample structure. However, there is no agreement on recommended sample size. The sample of 150 students can be adequate for factor analysis. Research showed that sample size can be adequate in a small sample size of 50 cases, however, other items such as communalities (>0.6) and sample to variable ratio in factor analysis can justify the use of factor analysis.

ii) *Sample to variable ratio (N:p ratio):* The ratio represents how many responses are required for each extracted factor. Williams et al. (2012) showed that there is disagreement in literature of what is an adequate ratio. In this dataset of student activities, the 2:1, 3:1, 4:1 and 5:1 ratios are acceptable despite the small number of variables (19 activities), thus, factor analysis was repeated until best ratio was accepted to minimise distortion of variables among extracted factors. Ratio 3:1 was the most suitable for this dataset.

iii) *Factorability of correlation matrix:* A correlation matrix is used to show the relationship between individual variables. A correlation of 30% and above within the data is considered appropriate for factor analysis as it shows common variance among variables. Following the guidance of at least 30% factorability explained by the variance, the dataset shows that 46.203% of variance is explained, hence, it was considered appropriate for factor analysis.

iv) *Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy/Bartlett's test of sphericity:* The KMO index is recommended when variables ratio is less than 5:1, thus, in this case KMO is calculated. The KMO index ranges from 0 to 1, with index 0.50 and above considered suitable for factor analysis. Bartlett's Test of Sphericity should be significant (p<0.05) and suitable for factor analysis.

In Table 5.7, the result from SPSS calculated KMO (KMO=0.852) and Bartlett's test (p=0.000<0.05) shows that factor analysis is adequate for this set of data.

Table 5.7: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.825
Bartlett's Test of Sphericity	Approx. Chi-Square	797.676
	df	171
	Sig.	.000

3. ***Variable extraction:*** To understand factor extraction, the PCA can be used for factor extraction. Other extraction methods in factor analysis include unweighted least squares, generalised least squares, maximum likelihood, principal axis factoring, alpha factoring and image factoring. The commonly used PCA method is also selected in this data analysis because it is commonly used in similar data analysis.

4. ***Criteria to determine factor extraction:*** Using multiple approaches in factor analysis is recommended. Among those used are Kaiser's criteria (eigenvalue>1), the Scree plot test, the cumulative percent of variance extracted, and parallel analysis. The eigenvalue is by default set to 1 in SPSS. Factor analysis with SPSS was able to extract 7 factors, however, some variables have rotation values that are distorted among more than one factor. Therefore, the number of factors pre-specified and the factor analysis reran in SPSS to generate six, five, four, three factors and then two factors. A number of three factors were found to best describe the dataset, as the variables show meaningful correlation with the three factors.

5. ***Selection of rotation method:*** In order to generate a simple solution that can be easily interpreted, rotation methods are used in factor analysis to see if a variable relates to one or more than one factor (Williams et al., 2012). The commonly used categories were Orthogonal and Oblique. Some Orthogonal rotations include Varimax, Quartimax and Equamax, and Oblique, Olbimin and Promax. It was expected that the factors were to be correlated, thus Orthogonal rotation was used based on Varimax. A cut-off for size of 0.40 was applied in which each item was loaded onto one factor only, hence one item (Composing music) was removed from the analysis, as shown in Table 5.8.

   Results from Table 5.8 were obtained after running factor analysis using SPSS. Table 5.8 also shows three groups of activities with strong relationships used to reflect on student behaviours in user-generated content.

Table 5.8: Rotated component matrix – Cycle 1

Rotated Component Matrix			
	Components		
	1	**2**	**3**
Sending SMS			**.663**
Uploading digital camera photos			**.564**
Uploading mobile photos			**.722**
Using social networking websites (e.g.: Facebook)			**.713**
Participating in online forums		**.419**	
Creating YouTube clips		**.686**	
Creating websites		**.516**	
Using Twitter		**.532**	
Developing iPhone/iPad applications		**.413**	
Blogging		**.660**	
Creating and managing ePortfolio		**.641**	
Creating wikis		**.644**	
Rating products online	**.607**		
Creating Presentations	**.698**		
Creating and managing Databases	**.763**		
Adding product review comments	**.668**		
Writing documents	**.550**		
Creating graphics	**.595**		
Composing music			

(Extraction Method: PCA and Rotation Method: Varimax with Kaiser Normalization)

6. ***Interpretation:*** Interpretation of the factors to which variables are correlated are given a label that is descriptive, meaningful and gives an overall picture of correlated variables. Factor analysis applied on user-generated content activities suggested a three-component solution. Labelling the components was based on the common nature of the activities that can be found among each group of variables. The labelling was as following:

i) Factor 1: Participating in online forums, Creating YouTube clips, Creating websites, Using Twitter, Blogging, Creating and managing ePortfolio, Creating wikis, Developing iPhone/iPad applications).

ii) Factor 2: Rating products online, Creating Presentations, Creating and managing Databases, Adding product review comments, Creating graphics, Writing documents.

iii) Factor 3: Sending SMS, Uploading digital camera photos, Using social networking websites (e.g.: Facebook), Uploading mobile photos.

Factor 1 consists of activities that can lead to public benefits, as described in Section 5.2.4.1, where anyone can participate and benefit, even non-participants. Hence, Factor 1 can be labelled as *public activities*. For example, creating public resources, such as wikis and blogging, allows sharing and contribution by anyone.

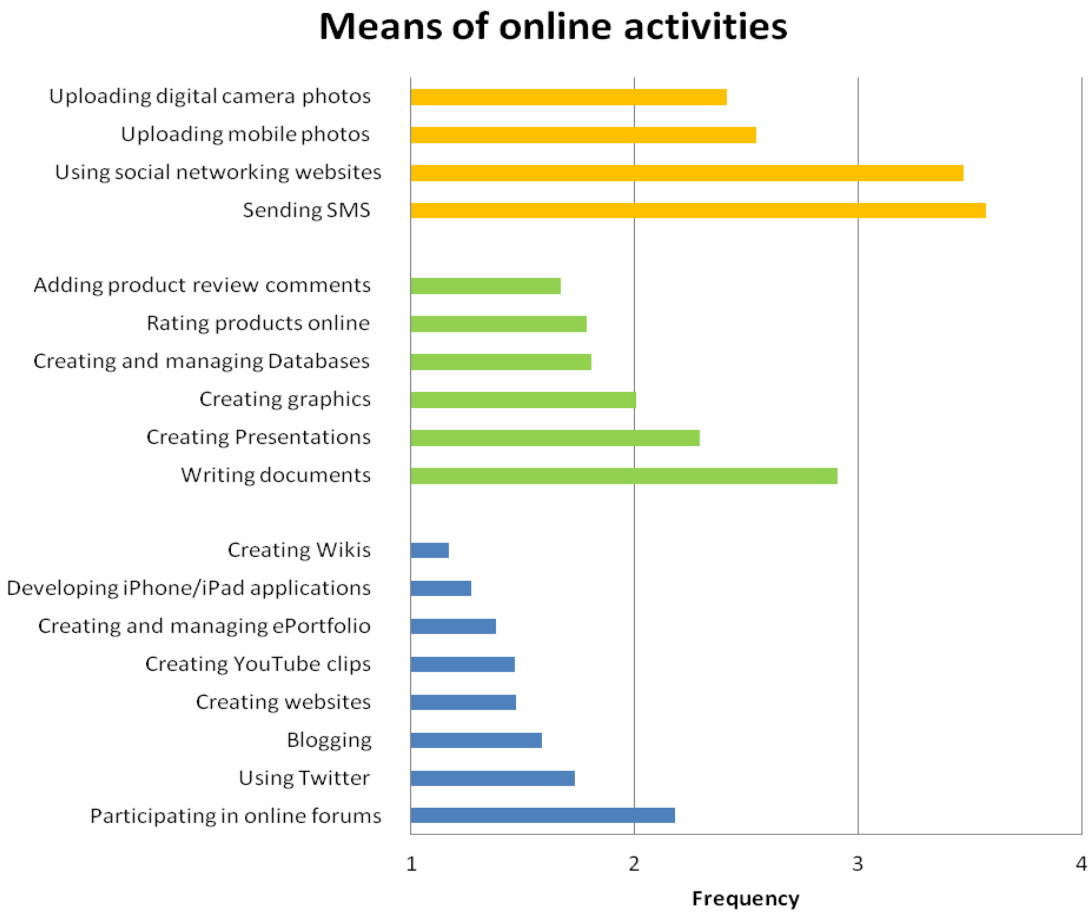
Factor 2 can be described as *communal activities* where there is mutual sharing that derives much value for participants, and have little or no value for non-participants, and Factor 3 can be described as *communal acts*. For example, rating products and adding review comments are the types of activities that interest a particular group of people.

Factor 3 can be labelled as *personal activities* where all activities, such as uploading photos, are done by uncoordinated individuals, and the benefits are usually personal.

From the perspective of cognitive surplus, the three factors consist of activities that can lead to public, communal and personal values. Therefore, online contributions that students make can be of lasting value (Shirky, 2010). However, to obtain real value of these activities, they need to be harnessed in an effective manner.

Student responses showed that they were more active on personal activities than communal and public activities (Figure 5.6). However, Shirky (2010) argued that because people are motivated by personal and social motivations, harnessing social motivation by sharing activities can dramatically increase their value.

It can also be concluded that students mostly engage and participate in online activities that have personal values gained from the presence of others. One such activity is ‘Using social networking such as Facebook’, explains the high rate of activities and also with recent research studies of the high rate of use of social networking website in America (Lenhart, 2015). However, for students to gain real value from their online presence, social motivation needs to be established for them to transform their cognitive surplus into public and civic values for others.



4 = Daily; 3 = Very Often; 2 = Occasionally; 1 = Never

Figure 5.6: Means of frequencies of online activities – Cycle 1

In the last part of the data analysis, a similar comparison approach to the one in Subsection 3 has been conducted to identify if there is a correlation between types of user-generated content that students do on the internet and their marks in generating the learning resources. Results from Table 5.9 show that the frequency of student activity on different types of user-generated content are public activities (mean = 1.52 SD 0.45) and communal activities (mean = 2.06 SD 0.53) activities that are both set between ‘Occasionally’ to ‘Never’ and personal activities (mean = 2.99 SD 0.59) between ‘Daily’ to ‘Very Often’. The mean from each category in Table 5.9 is used as a threshold to compare student marks.

Table 5.9: Measures of central tendency of student marks in correlation to three categories (factors) of user-generated content activities – Cycle 1

User-generated content activities (n=127) Total score = 15	Mean*	count	Percentage	STD	Median	Min	Max
Public activities (threshold = 1.52)							
Less than threshold	9.44	80	63%	1.38	9.45	4.5	15
Above threshold	9.62	47	37%	1.83	9.75	3	14.4
Communal activities (threshold = 2.06)							
Less than threshold	9.52	75	59.1%	1.53	9.45	4.5	15
Above threshold	9.48	52	40.9%	1.61	9.75	3	12.3
Personal activities (threshold = 2.99)							
Less than threshold	9.08	46	36%	1.38	9.3	4.5	11.55
Above threshold	9.74	81	51.2%	1.61	9.9	3	15
All activities (threshold = 2.19)							
Less than threshold	9.3	65	51.2%	1.36	9.45	4.5	12.3
Above threshold	9.71	62	48.8%	1.72	9.75	3	15

* Project weight = 15 marks

Similar relationships have emerged among all groups of activities, as (r^2) values were positive for communal (0.12) and personal (0.20) activities where (r^2) was 0.09 between student marks and public activities formed a linear relationship. However, the emergence of positive relationship between user-generated activities and their marks in generating learning resource need further data to support the results as (r^2) value was 0.18 and does not provide a sufficient relationship between the two variables.

A follow-up question in this part of the survey asked students about their actual user-generated content. The purpose of the question was to validate the results of student responses to online activities. Students were also asked to provide examples of their user-generated content by providing web links.

> *In your own free time have you created digital content that can be published on the internet?*
>
> *What is the type of this digital content?*
>
> *Can this digital content be used as learning content (i.e. to help others learn something)?* (Appendix D)

The response rate for these questions was 100%, however, only 22.7% (n=34) answered ‘Yes’. The 34 respondents with a positive answer submitted 40 examples of user-generated activities of their work, including 24 respondents stating that their content can be used as learning resources. However, only 12 students said they published their work online by providing genuine web links to their user-generated content.

The data analysis showed that this cohort of students engaged in online activities that led to personal benefits, however, they were not interested in producing content on the internet, as they showed limited examples of user-generated content in the follow-up question. Therefore, it would be necessary to establish motives for these students to become engaged in activities that have benefit to oneself to activities that can be shared and enjoyed by others.

Finally, the aims of this thesis is (i) to tap into student-generated content for educational purposes; (ii) to understand student contributions to user-generated content outside educational boundaries’ and (iii) to determine if student engagement in user-generated content affects their performance in generating student-generated learning resources.

5. Experience with student-generated content

Emphasis has been placed on the importance of student-generated content in previous research. Tapping into this content has been researched through engaging students in generating digital story by teaching them filmmaking techniques (Kearney et al., 2012; Matthew et al., 2011), enhancing student writing skills using wikis (Begoña & Carmen, 2011) and building student-generated assessments (Bates & Galloway, 2013).

However, cognitive surplus inside classrooms is still ephemeral, and live examples that can be reused by others are still hard to find (Bull, 2008; Sener, 2007). The example from the Student As Producer project (Neary, 2010) provided real evidence of the engagement of students in generating learning resources. However, this project is supported with institutional funding. Therefore, tapping into student-generated content that university students normally do as part of their learning process can dramatically minimise this cost of human resources.

Therefore, as one of the main aims of the survey was to understand student experiences in generating content inside the classrooms, data was collected to determine whether students had created student-generated content, identified by the name of the study unit, description of the content, title and type of the content, and whether it is published online. As the term 'student-generated content' could be ambiguous to the participants, it was explained in the survey as creating digital content for educational purposes. Student responses showed that there is relatively more activity inside the classroom than outside in terms of important content. A number of students (42.7%, n=64) said that they had created digital content for educational purposes, giving 67 examples of their previous work. Among this percentage, 46 students said that their content can be used as learning resources. However, publishing activities was lacking as only three students said their work was published online. Finally, the marks of students who experienced student-generated content (mean 9.3 STD 1.44) were compared with those who had no experience (mean 9.6 STD 1.64).

5.4.4 Cycle 1 of Iteration 0: Outcome

Cycle 1 of Iteration 0 helped in evaluating the proposed OER development model in the real life educational environment, and assessed how well its main components work together. From the initial evaluation of the model, the following modifications were carried out to the next cycle:

1. **Model integration into an undergraduate study unit:** It was identified that an introductory presentation for participating students about the model was necessary. This included meeting with students and explaining their roles in the research, as well as the benefits of OER in higher education. The presentation was to establish the incentives for students to become engaged in the OER development process and adopt OEP.

2. **Suitability of the study unit to the model:** The model was a promising path in the 'Introduction to IT' unit where the large sample size provided statistically reliable results. The heterogeneous academic backgrounds of participating students helped to produce a diverse set of learning resources.

3. **Data collection:** Modifications were required to some parts of the survey questions, including modifications to the structure of some lengthy questions that asked students about providing more examples of their user-generated content experience and student-generated content experience. There was also a need to collect data about student motives to create and share different types of content. According to Shirky (2010), intrinsic motives were behind the generosity of sharing creative work. Asked about the motives to generate online content outside classrooms, support is needed to identify how to capture this passion seen outside the classroom and engage students inside the classroom to connect with academic goals (Bull et al., 2008).

4. **Survey timing:** It was important to collect student responses at the beginning of the semester because student experiences in creating their projects during the semester can affect part of the questions being asked about student-generated content.

5. **Collaboration between the researcher and participants:** From Cycle 1, the unit coordinator was experienced in generating online learning resources for university students and teaching different units in the SCEM which helped to provide the technical scaffolding required for students in the OER development process.

5.5 Phase Four

The purpose of Phase Four is to reflect on implementing the research and documenting the iteration. The initial design principles of Phase Two in Section 5.3 were modified based on the outcome of model implementation in real life, as follows:

1. Raising awareness of the value of openness between the unit coordinator and students through conducting a workshop during the semester.

2. Integrating the OER development model in a real educational setting by developing a learning approach that integrates student-generated content as part of a study unit.

3. Utilising existing OER repositories in learning design and teaching practices and avoiding repetition.

4. Establishing communities of practice around OER that consist of students as content generators and teachers as facilitators of the development process.

5. Repurposing cognitive surplus of student-generated content towards building learning resources for OER.

The above design principles of the proposed OER development model were carried out to Iteration 1 of the research where a more informed design is implemented based on Iteration 0.

5.6 Summary

This chapter presented Iteration 0 of the conducted research of this thesis. The structure of Chapter Five aligned with the four phases of the DBR methodology, which has been followed throughout the research. The extended theoretical framework of the research, presented in Phase One, consists of the role of openness in education, student-generated content and cognitive surplus. This framework has informed the initial design principles and OER development model as proposed in Phase Two on which the initial design principles emerged. Chapter Five also emphasised the role of openness in higher education as important innovating pedagogies in the current era, and that there is a significant role for educational institutions to embrace OEP to help realise the value of openness in learning and teaching. Therefore, the proposed OER development model: (i) highlights its design principles; (ii) raises awareness of the value of openness between students and teaching staff through adopting OER and OEP in learning and teaching practices; and (iii) avoids duplications of an existing model. The chapter also presented the theoretical benefits of adapting student-generated content in the learning process and stressed the need for more evidence of tapping into student-generated content. As a response to this need, the chapter presented the starting stage of the proposed OER development model that taps into student-generated content in one study unit. The abundance of student-generated content is described, using concept cognitive surplus where lessons learned from tapping into cognitive surplus in social networking websites have been reflected in the educational context through tapping into student-generated content in the OER development process.

Phase Three provided practical evidence of the feasibility of the OER development model in real life educational settings, and highlighted the need for increased technical support for students in generating learning resources. The required scaffolding is identified in helping students with structuring the learning design of the learning content, and introducing them to new content authoring software tools. The chapter concluded with Phase Four showing the new and modified design principles that were carried out in Iteration 1 of the research.

Applying the OER development model in practice proved that there is an opportunity of tapping into student-generated content and integrating it as part of teaching units. However, results from the data analysis showed that students can be introduced to additional tools to generate the learning resources. Data analysis also reflected the types of user-generated content that students are engaged in, showing that they can lead to obtaining personal values of their online presence. However, recommendations on extending the implementation of the model in additional iteration were raised in order to obtain further data to help support the data analysis outcome.

The iterative nature of DBR methodology supported the research process, as well as the development of the design principles. Hence, the growing stage of the research process allowed additional implementation of the solution in the learning environment, refined the initial design principles and helped with collecting further data, as in Chapter Six.

CHAPTER SIX: GROWING STAGE OF THE OPEN EDUCATIONAL RESOURCES DEVELOPMENT MODEL – ITERATION 1

6.1 Overview

The initial OER development model was described and implemented in Iteration 0 of the research during which the feasibility of the proposed model was assessed, as presented in Chapter Five. Based on the outcome of the starting stage (Iteration 0), the OER development model was recommended to be integrated into the 'Introduction to IT' (300134) unit as part of the teaching strategy of the unit for another iteration. Therefore, Iteration 1 marks the growing stage of the conducted research in which modified design principles took place in the same study unit of the previous iteration for the academic semester Autumn 2013 (March to June), as presented in Figure 6.1.

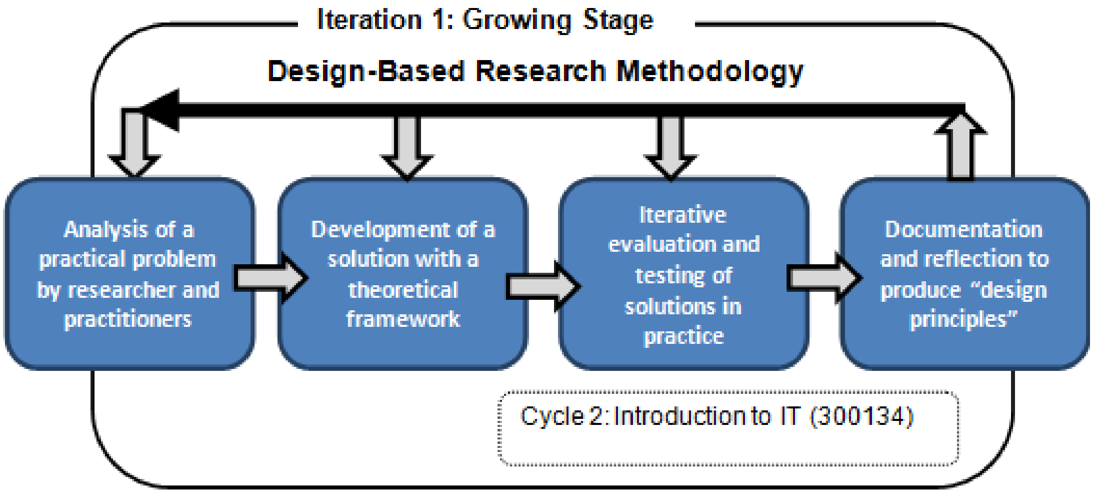


Figure 6.1: Growing stage of the OER development model

However, advancing the research and the proposed model from feasibility assessment in the starting stage to thorough implementation in the growing stage required obtaining ethics approval. Prior to commencing Iteration 1, ethics approvals were obtained from the Human Ethics Committee at WSU. A summary of all ethics approval that were obtained during the research are provided in Appendix C.

In this chapter, an extended revision of the literature review took place to explore the readiness of university students on using new ICT that included content authoring software tools to generate OER. Long debate has existed about the younger generation being ‘tech savvy’, however, in this thesis the position is that they are enthusiastic about towards using ICT in their learning rather than being born digital, and that they are surrounded with technology in every aspect of their lives, making them better users of technology than their predecessors or the older generations. Nonetheless, the younger generation has developed basic skills in using new technologies, and it is the role of educators to tap into their skills and enthusiasm in their learning experience. Additionally, learning approaches developed by educators need to harness student skills through technical scaffolding and collaborative work in student-teacher relationships. Among these approaches that is the focus of the learning design in this thesis is the learning approach where students take the role of knowledge producers, and teachers become the co-creators of knowledge production.

During Iteration 1 of the study, additional data were collected to clarify the relationship between student skills in: (i) using content authoring software tools; (ii) contributing to user-generated content and student-generated content; and (iii) performing student-generated learning resources. Recommendations from the growing stage are carried out to refine the initial design principles of the proposed OER development model.

6.2 Phase One

As explained in Chapter Four Section 4.5, Phase One starts with identifying and exploring a significant educational problem through collaboration with stakeholders, including researchers and practitioners, and reviewing the literature. In Iteration 1, a unit coordinator was assigned to the ‘Introduction to IT’ unit. Hence, as a part of raising awareness of OER in higher education, it was important to start discussions with the coordinator about the significance of the research and the purpose of including the ‘Introduction to IT’ unit. The area of tapping into student-generated content was highlighted during the meeting as a main resource for the proposed OER development model. Hence, development of design principles of the OER development model required the unit coordinator to be aware of the benefits of OER and the value of integrating the model in the study unit.

As Figure 6.2 shows, the literature review was extended to explore the technical skills of university students in using new technologies. The term ‘digital natives’ is explored in the extended literature review, as it is claimed that university students introduced technology as a norm to their classrooms (Prensky, 2001a).

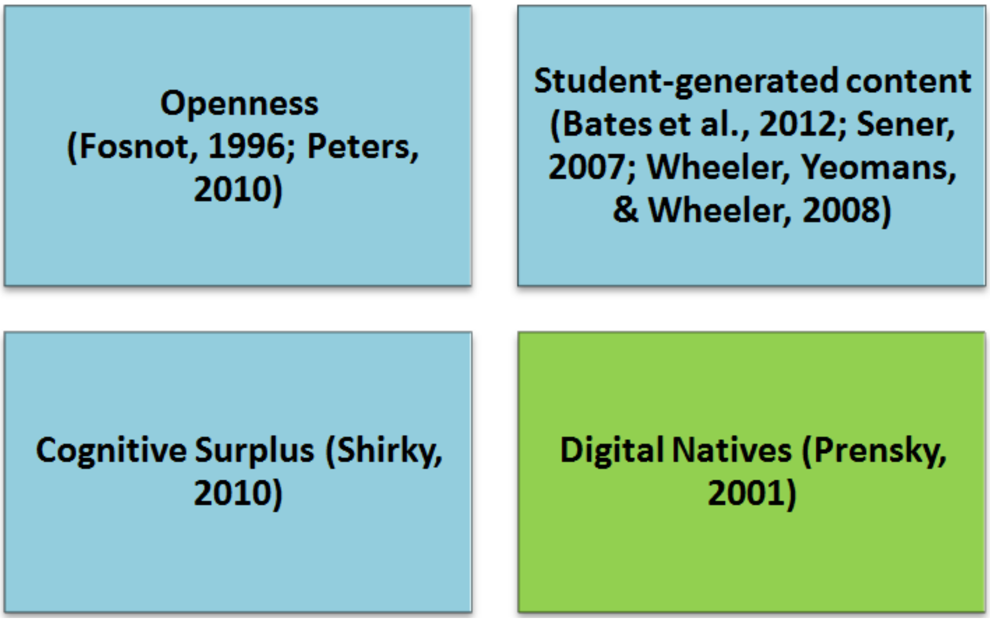


Figure 6.2: Phase One of Iteration 1: Extended literature review map

6.2.1 Digital Natives

New ICT are being integrated into different aspects of life. Education is among the main sectors that have been influenced with integration of ICT, particularly in the ways in which people learn and what makes effective pedagogy (Beetham & Sharpe, 2013).

As new generations of students embraced ICT in almost every aspect of their lives, metaphors were coined to describe their behaviours. In previous research, the terms digital natives (Prensky, 2001a), millennial learners (Strauss & Howe, 2000), digital generation (Tapscott & Ebrary, 1998) and net generation (Oblinger, D. & Oblinger, J., 2005) are popular with young students born in the early 1980s. Currently, the terms are in use and describe the new generations born to embrace technology in almost every aspect of their lives and described as being ‘tech savvy’.

In educational contexts, Prensky (2001a) claimed that the younger generation is no longer those whom our educational system was designed for as the conventional learning system is designed for people who have a different thinking style from the ‘digital natives’. Prensky

(2001a) also argued that the educational system is challenged by the digital divide between two generations and that ‘our digital immigrant instructors who speak an outdated language (that of the pre-digital age) are struggling to teach a population that speaks an entirely new language’ (Prensky, 2001a, p. 2).

Research on empirical evidences that supported or declined digital native claims and alternative terms started to take place in the last few years. Importantly, there is no empirical evidence to support digital native claims and implications for using new technologies for learning and teaching are limited to basic skills and narrow use of new technologies (Bullen, Morgan, & Qayyum, 2011; Pedro, 2009).

Thompson (2013) conducted a study in the Midwestern United States that surveyed 3000 students to gather data on the use of new technologies by university freshmen. The study aimed at understanding the degree to which technology affect student learning approaches in terms of focused attention, deep processing of information, and persistence. Results showed no significant relationship between digital native claims and student learning approaches. Furthermore, the study showed negative correlations between some categories of technology use and the productiveness of student learning behaviours.

Another research on thousands of students of all ages by the Open University of UK showed that older and younger people differ in how they use technology and there is no clear break between the two populations in study habits (Jones & Hosein, 2010). Vassileva (2009) also argued that younger students tend to have a shorter attention span, especially when faced with traditional learning, and that educators complain that young people are less efficient in their schoolwork. It was also found that their engagements with digital technologies are varied and often ‘unspectacular’ (Selwyn, 2009).

Additionally, other empirical studies of digital natives focused on investigating types of learner use and access to technology (Kennedy, Judd, Churchward, Gray, & Krause, 2008; Kennedy, Judd, Dalgarno, & Waycott, 2010; Van den Beemt, Akkerman, & Simons, 2011). These studies showed that the idea of digital natives does not provide evidence of a better use of technology to support learning. Rather, educators should consider the diversity of student preferences in using new technologies to support learning. In the same context, another study from Spain showed that the educational model, either face-to-face or online (Greenfield, 2002), has a stronger influence on student perception of the usefulness of ICT support for learning, and that the learning environment advances student digital competencies rather than being digital natives (Gros Salvat, Garcia, & Escofet Roig, 2012).

The position towards young generations can be seen from the different perspectives as the debate has taken many directions since the introduction of the terms Digital Natives, Millennial and Net Generations. Therefore, some researchers tend to examine the biological perspective of how human brain adapts to the use of ICT and how new technologies influence learning activities.

Neuroscience is considered a powerful set of practices that can reveal important information about human brains and people identities (Pickersgill, 2013). Recent studies of neuroscience methodologies were established in research of educational technology (Anderson, Love, & Tsai, 2014). There is a strong position in neuroscience stating that for new generations of university students, the fact that they were born in the digital era have actually influenced their brains to be developed and to better adapted to the ubiquity of ICT in almost every aspect of life (Choudhury & McKinney, 2013; Small & Vorgan, 2008, p. 104). As a result, younger generations have developed learning skills, such as multitasking, scanning, access to, integrating of and quick search for information and non-linear learning (Oblinger, D., Oblinger, J., & Lippincott, 2005; Veen, 2003). In addition, younger generations have also developed online writing skills and participated in user-generated content (Gibson, 2008; Lenhart, Arafeh, & Smith, 2008).

Hence, results from the neuroscience field suggest that exposing younger generations to new technologies has developed some skills. Nonetheless, these skills are basic and limited to simple cognitive skills. Therefore, it can be stated at this stage that it is the role of educators to develop new learning approaches that repurpose student basic skills that emerged as a result of exposure to new technologies in a way that can help them to improve their learning performance. Additionally, new technologies need to be treated as supporting tools of the learning process, and to be customised according to the requirements of the learning environment, rather than being treated as a norm that students bring to their classrooms. Further, the ubiquity of technology in the current era can be seen as an equivalent to the ubiquity of the printing press since 1450s, although the printing invention of Gutenberg did not transform its generation to become writers just because they were born in the same era. Willingham (2010) argued that the integration of new technologies into learning environments requires teachers to monitor the performance of their students in order to measure learning that can happen or whether they gain benefit, and teachers should treat technology as another tool that can scaffold students learning, but not as the cause of learning.

Additionally, even though the previous research declined the generational gap between young generations and their teachers using new technologies (Bullen et al., 2011; Pedro, 2009; Selwyn, 2009), Small and Vorgan (2008) raised the call for new advances in educational technology where both generations needed to learn to work and communicate with each other (p. 189). Additionally, utilising ICT in learning should not indicate separating teachers from the actual learning process by allocating administrative role for them because this is not enough to benefit from ICT in improving learning performance for students (Campbell, Zuwallack, Longhurst, Shelton, & Wolf, 2014).

In conclusion, there is a need to initiate ICT to develop learning interventions that can support the establishment of communities of practice of students and teachers inside higher educational institutions. Therefore, learning interventions must cater for the needs of new generations of students and repurpose the skills they have developed in order to engage them in their learning experience, as engagement is known to lead to improve learning. Additionally, bringing students and teachers as partners and co-creators of knowledge together in the learning process can help to better utilise technology in learning environments.

6.2.2 Student-generated content as a type of cognitive surplus

Section 5.2.3 highlighted the emergence of online user-generated content as a result of the introduction of Web 2.0 tools that have been mapped to formal education, and termed as ‘student-generated content’ to refer to online content that students create as a result of interacting with Web 2.0 tools in the learning environment. Section 5.2.4 described the concept ‘cognitive surplus’ that refers to the abundance of user-generated content that people create as a result of collaborating with online communities in which they create opportunities for others. The section stressed that there is a need to tap into cognitive surplus in formal education. Section 5.2.4.2 responded with examples of cognitive surplus in higher education and argued that engaging students in generating learning resources that can be shared as OER is a new model of learning that can bring important value for students, teachers, institutions and other learners. However, there is a need to understand the capabilities of students using Web 2.0 tools and their contributions to user-generated content, as well as the quality of their student-generated content. Understanding student skills in generating online content can help to repurpose their skills in learning activities and engage them with their teachers in the process of generating learning resources that can be shared openly via OER.

Young people use social media more than other demographic groups (Pew Research Center, 2014). A recent research study by Pew Research Center investigated the use of the internet in America conducted on 1,060 teen aged 13-17 years between October 2014 and March 2015. As the widespread of smart phones facilitated online access, the study revealed that 24% of teens go online ‘almost constantly’, more than 56% of teens go online several times a day, 12% reported once-a-day use, 6% of teens report going online weekly, and 2% go online less often (Lenhart, 2015). The same study asked participants about their use of social networking websites and server platform options. The majority of teens (71%) reported using more than one social network site out of seven platform options they were asked about. Where Facebook (41%) was the dominant website for teens, other platforms, including Instagram (20%) and Snapchat (11%) are used more frequently by teens. Additionally, young adults of aged 18-29 years remain the dominant users of social networking websites between 2005 and 2013 (Pew Research Center, 2014).

As young people participate in social networking websites and generate online content by spending more hours in different online activities, they can be developing skills. Section 6.2.1 highlighted that students are developing new skills such as multitasking, scanning, access to, integrating of and quick search for information and non-linear learning, online writing skills and participating in user-generated content (Gibson, 2008; Lenhart et al., 2008; Oblinger et al., 2005; Veen, 2003). However, unless these skills are harnessed by educators in a way that repurpose students’ enthusiasm towards technology, such skills will remain at their infancy. Additionally, it is important to understand what motivates students to be active in informal online communities, as when some students attend classes, their teachers complain that this enthusiasm towards technology goes out of them (Bull, 2008; Vassileva, 2009).

The cognitive surplus concept suggests that intrinsic motives are usually the main drive for people to contribute to online activities such as creating and sharing user-generated content (Shirky, 2010). Deci and Flaste (1996) also suggested that acting autonomously, feeling competent, being connected and sharing are the motives that drive people’s performance in most of cognitive activities. Harnessing such motives can play an important role in engaging students to generate content for educational purposes that can be shared online. Importantly, engaging students and their teachers in the development of content can have a significant effect on the student learning process as students and teachers share equal responsibilities of generating the content that would lead to better engagement.

In this research study, the proposed OER development model is aimed at establishing communities of practice of students and their teachers, and engaging them in generating learning resources that can be shared as OER. Therefore, understanding student skills and experience in user-generated content and student-generated content will help to design proper technical scaffolding in using software content authoring tools. Additionally, understanding what motivates students to participate and contribute in social networking sites can help improve the design of the OER development model.

6.3 Phase Two

The extended literature review helped with the development of the design principles of the OER development model. Principle Two updated the initial list of principles of Iteration 0 based on the extended literature review of the current chapter:

Principle Two (modified): Understanding the feasible scope of the OER project

In addition to starting a small OER project and adapting OEP, the literature review and Cycle 1 showed the need for:

1. Raising awareness of the teaching team of the value of integrating OER in study units by reviewing the benefits and opportunities of OER for higher education.

2. Raising the awareness of the value of OER and OEP in higher education by introducing students to OER and their benefits during workshops. This introduction to OER allows students to realise the opportunities that OER can offer them and the value that they can add to the community by generating and openly sharing the learning resources.

3. Understanding student motivations to create and share learning resources by collecting data about their motives and establishing motivations for them to participate.

6.4 Phase Three

In the growing stage, the implementation of the OER development model in real-life settings is based on the recommendations from the starting stage (Iteration 0) and Phases One and Two of Iteration 1. The outcome of Phase One in Iteration 1 focused on the use of ICT by university students and repurposing their enthusiasm towards new ICT in important activities. Therefore, in Iteration 1, the implications from Phase One and Phase Two have influenced the implementation of the OER development model in Phase Three which consisted of one cycle.

6.4.1 Cycle 2 of Iteration 1: Description

Cycle 2 of Iteration 1 took place during the academic semester autumn 2013. The participants were students enrolled in the ‘Introduction to IT’ (300134) unit as in Cycle 1 of Iteration 0. As an introductory unit, ‘Introduction to IT’ is offered to students from all schools, which makes the enrolment number relatively higher than other advanced units. Having a large number of participants gave the opportunity to work with students from different academic backgrounds, which helped to correlate between student academic backgrounds and quality of student-generated learning resources. This correlation supported the final design principles that benefited students when integrating the OER development model within a study unit.

Learning scaffolding of participants of the learning resources took place online and in the class. Students were provided with general guidance on how to generate learning resources through vUWS. A series of introductory presentations also took place during the semester that highlighted the benefits of student-generated content and participation in generating OER, as well as the importance of OEP in higher education. The presentations were held during the first 20 minutes of each tutorial session.

The aims of conducting Cycle 2 were:

1. Validating the recommendations from Iteration 0 to enhance the design principles of the proposed OER development model and integrate the modified model into a study unit.

2. Collecting additional data about student skills in using content authoring software tools and their experience in user-generated content and student-generated content.

3. Understanding the technical skills of the teaching team in using educational technology to support their students in developing the learning resources.

6.4.2 Cycle 2 of Iteration 1: Participants

A total of 216 students were enrolled in the ‘Introduction to IT’ unit for the academic semester autumn 2013. Only 188 students submitted their projects through vUWS.

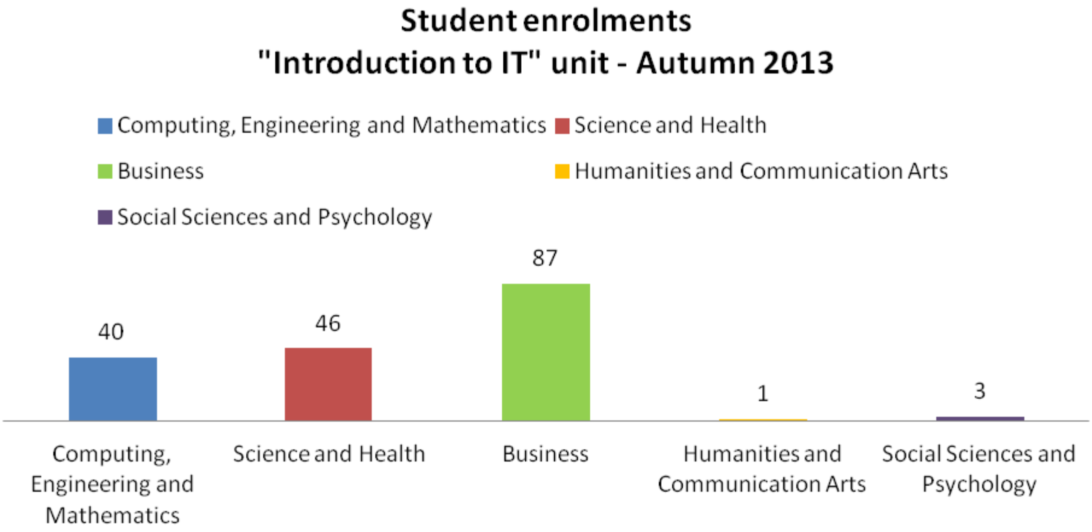


Figure 6.3: Distribution of student enrolments at ‘Introduction to IT’ grouped by school name – Cycle 2

Students were from different background, as the unit was offered to all university students. Figure 6.3 shows the distribution of participants among six schools at WSU.

As Figure 6.3 shows, the majority of participants came from SCEM, School of Science and Health and School of Business, therefore, results strongly related to these schools. Reusing the final design principle of the OER development model is recommended in learning environments where students are from similar academic backgrounds.

The role of the practitioner is important in DBR methodology, as presented Chapter Four, in particular, the experience of the unit coordinator in integrating the OER development model into the learning environment. Therefore, the design principles of the proposed model reflected the role of the unit coordinator in the learning environment, and emphasised the technical and learning scaffolding that the unit coordinator was required to provide the students. In Cycle 2, the new unit coordinator was introduced to the research development model and integration of the OER development model in the ‘Introduction to IT’ unit. Additionally, as the OER development process was new to the SCEM, raising awareness of OER in learning and teaching and the OER development process were introduced in the discussion with the new unit coordinator.

6.4.3 Cycle 2 of Iteration 1: Data collection and analysis

Data collected in Cycle 2 consisted of two categories similar to Cycle 1, which included data collected from student projects and student responses to the online survey. The following subsections provide further details on data collected from each category.

6.4.3.1 Students projects

One hundred and eighty-eight students completed the unit and submitted their projects (learning resources). Table 6.1 shows the number of projects, mean and standard deviation of student scores according to their schools.

Table 6.1: Descriptive statistics of marks of student projects grouped by schools names – Cycle 2

School name	Number of projects	Percentage	Mean*	Standard deviation
Computing, Engineering and Mathematics	40	21%	9.06	1.37
Science and Health	46	24%	9.39	1.82
Business	87	46%	9.23	1.74
Humanities and Communication Arts	1	1%	7.65	-
Social Sciences and Psychology	3	2%	8.33	1.15
Others	11	6%	9.23	1.61

*Project weight = 15 marks

Cycle 2 was similar to Cycle 1 in terms of student academic backgrounds, that is, 92% were from the SCEM, School of Science and Health and School of Business. Also similar to Cycle 1, students from School of Science and Health achieved better performance in developing the learning resources. Even though the context of this study is the SCEM ‘Introduction to IT’ unit, students enrolled from other academic background (Figure 6.3). Interestingly, the digital natives claim assumes that students who were born in the digital age have technical competences in using new ICT, as discussed Section 6.2.1. However, in this part of the analysis, data in Table 6.1 shows that students from the SCEM did not perform better than students from other academic backgrounds. Therefore, students who were identified as digital natives and possessing a technical background were not able to show better learning outcomes in generating learning resources when comparing the results to students from other schools.

Students also had the choice of using one of the content authoring software tools from a list of tools in the unit learning guide. Student performance was based on the content authoring tools used, as presented in Table 6.2, which reported on 176 only, as 12 missing projects could not be collected.

Table 6.2: Descriptive statistics of marks of student projects grouped by content authoring software tools – Cycle 2

Content Authoring Software Tools	Freq. of use	Percentage	Mean*	STD
Apple iBook Author	1	1%	9.75	-
Narration tools (Adobe Articulate, BrainShark, Camtasia)	19	11%	9.58	1.47
Mobile Applications Development	0	0%	-	-
Interactive Microsoft PowerPoint, Adobe PDF and Prezi	82	47%	10.02	1.33
Content based Microsoft PowerPoint, Adobe PDF files and Microsoft Word documents	52	30%	7.93	1.03
YouTube Instructional Videos and Quiz	12	7%	8.65	2.02
Simulation tools (Adobe Flash, iSpring)	8	5%	9.77	1.82
HTML format files	2	1%	9.38	4.77

*Project weight = 15 marks

Almost half of the students, 47% (n=82), used Microsoft PowerPoint, Adobe PDF and Prezi and scored an average of 10.02 (STD 1.33). The second largest group of students, 30% (n=52), scored an average of 7.93 (STD 1.03). The developed learning resources of this group lacked interactivity with the end-user and content was a basic representation of information. The remainder of the students, 24% (n=42), developed their learning resources by using other tools that provided a better level of interactivity.

The main concern from Table 6.3 shows the increased number of content-based learning resources compared to the same category in Table 5.4 in Cycle 1 as the percentage of using content-based Microsoft PowerPoint, Adobe PDF and Microsoft Word documents was only 9% (n=20) compared to 30% (n=52) in Cycle 2. The implications of this result led to an urgent call for scaffolding students on developing interactive learning resources rather than content-based resources. Further observations of the learning resources developed by students were that learning resources lacked proper instructional design of the learning content. For example, none of the learning resources showed a table of content at the beginning of the learning resources, and there were no explanation of learning objectives for any of the learning resources.

Student projects (learning resources) were assessed based on the same criteria used in Cycle 1 (interest and usefulness, product, design, multimedia and interactivity). The criteria evaluated the learning resources from a technical perspective, however, it did not assess educational or openness perspectives. Importantly, adjusting educational and openness criteria is important for the sustainability of the OER development model as publishing reliable learning resources is a crucial process for adjusting the quality of learning resources that will be disseminated associated the university's name. Hence, there was a need to develop a more comprehensive set of evaluation criteria in which educational aspects can be evaluated by the teacher to verify the accuracy of the learning content and the openness perspective to verify the fitness of the learning resources to OER.

6.4.3.2 Online survey – Student experience in generating online content

Iteration 1 marks the growing stage in the conducted research of this thesis, therefore, the online survey took place formally. Prior to attempting the survey, students were sent an invitation letter (Appendix A) through vUWS with a link to complete the consent form (Appendix B) and attempt the online survey. The online survey was launched in Cycle 1 on Week 3 of the academic semester and the response rate was 65%. Responses were gleaned from partially completed responses and filtered to 110 responses. Seventy-four students submitted both tasks, that is, the survey and their projects.

The survey collected additional data about student experiences in using content authoring software tools, user-generated content and student-generated content. Additional data were used in data analysis to further address the research question of whether a strong relationship exists between the quality of student-generated learning resources and their previous experience.

The survey consisted of six parts; (i) demographics; (ii) general experience with internet technology; (iii) student skills in using content authoring software tools; (iv) experience with user-generated content; (v) experience with student-generated content; and (vi) collected data about student incentives toward creating and sharing content online. Technical modifications were carried out to adjust the structure of lengthy questions to allow them to be easily completed by the students. In Cycle 2, the research selected 110 students aged 18-24 years to respond to the online survey. Previous research have argued that 18-24 year olds possess digital competencies and special learning needs for which the current educational system cannot provide (Cameron, 2005; Prensky, 2001a, 2001b; Willingham, 2010). Hence, data collected about the digital competencies of university students at the undergraduate level helped in understanding the real profile of this cohort of students in terms of digital competencies and whether the digital natives claim is valid, or they were showing enthusiasm towards new ICT. Sections 1-6 describe the data collected from the participants, as follows:

1. Demographics

The sample consisted of 63 male (57%) and 47 female participants (43%). The majority were Australian residents (98%) with the remainder being international students (2%).

2. General experience with internet technology

Forty-four students (44%) described themselves as having strong competency in using technology, while the remainder (55%) stated they have average competency in using technology. Only six (5%) students said they have less than average of competency in using technology, and none of the students said that they have no competency. Students were asked about their Web presence in one or more of the content generation websites. Table 6.3 shows detailed responses by students on web presence.

In terms of the number of daily hours that students spend on the internet, 76.2% said they spend more than four hours each day. The average time spent online for the complete sample was equal to five hours and 27 minutes. This result is very close from the result in Iteration 0, which showed that students spend on average five hours and 53 minutes each day on the internet.

Table 6.3: Student web presence

Web presence	Percentage/frequency	
YouTube channel	35%	38
Photos or artwork collection	30%	33
Website/page	14%	15
Weblog	13%	14
Wiki	1%	1
Others	32%	35

Additionally, the longer time spent on the internet, the better the marks achieved by students in generating learning resources (Table 6.4). The last row in Table 6.4 has been discarded from the analysis due to the small number of respondents in this category.

Table 6.4: Measures of central tendency of student marks according to time spent online

Time online (n=74)	Mean*	count	Percentage	STD	Median	Min	Max
Less than 3 hours	8.96	20	27%	1.16	9	5.7	11.1
4-7 hours	9.05	39	53%	1.21	9	6.45	11.25
8-11 hours	9.87	11	15%	1.13	9.9	8.55	12.75
More than 11 hours	7.69	4	5%	1.26	7.69	6	9

*Project weight = 15 marks

As in Cycle 1, the survey in Cycle 2 asked students about their familiarity with the general terms related to OER. They said that they have a high level of awareness of ‘online copyrights issues’, ‘open learning’ and ‘open educational resources’, and listed these three at the top of the list. ‘Open access journals’ and ‘open-source software’ were listed as fourth and fifth on the awareness list. Unlike the sample from Cycle 1, in Cycle 2, students listed ‘Creative Commons’ as one of the least three terms they are familiar with, including ‘MOOC’ and ‘MIT-OCW’ at the bottom of the list.

3. Student skills in using content authoring software tools

Cycle 1 showed that all students were relatively more skilled in using common tools than advanced tools, however, those who said they are skilled in using the advanced content authoring tools were able to perform better in generating learning resources, as their marks showed in the projects assignment. This part of the survey continued to collect data from students about their skill levels in using content authoring software tools as data analysis from previous cycle showed that this factor could be a reason behind the improved quality of student-generated learning resources. On a Likert scale of 10, students were asked to report their skills level in using different content authoring software tools. The tools were arranged randomly in the survey, however, could be grouped into two types: (i) common tools (Windows Movie Maker, Microsoft FrontPage, Microsoft PowerPoint, Microsoft Publisher, Microsoft Word, Paint.NET); and (ii) advanced tools (Adobe Photoshop, Audacity, Adobe Flash, iBook Author, iMovie, Others). The completion rate for this question was 94.5% (n=104).

Overall, students reported higher skills levels in using common tools (mean 5.79; SD 1.65) and lower skills in using advanced tools (mean 2.93; SD 1.56). The advanced category tools consisted of useful tools in generating interactive learning resources that allowed embedding multimedia that helped with developing learning activities. However, a lack of competency in using these tools could be expected from students, although student responses confirmed the initial assumption of a lack of competency and raised the need for introducing advanced tools that were easy for them to understand and at the same time, provide a medium for embedding multimedia content to help them with generating good quality learning resources. Table 6.5 shows student responses in more details on tools in both categories. The median was calculated for central tendency as the standard deviation was large relative to the mean of advanced tools, hence, the mean is affected by outliers and skewed data.

Table 6.5: Descriptive statistics of student responses on skills level in using content authoring software tools – Cycle 2

Advanced Tools	Mean*	Median*	Std Dev.	Common Tools	Mean*	Median*	Std Dev.
Adobe Photoshop	4.92	5	2.54	Microsoft Word	8.82	9.00	1.57
Audacity	3.88	3	2.46	Paint.NET	5.72	5.50	3.15
Adobe Flash	4.66	4	2.47	Microsoft PowerPoint	8.00	8.00	1.83
iBook Author	2.52	2	2.03	Windows Movie Maker	4.60	4.50	2.97
iMovie	3.69	2.5	2.84	Microsoft Publisher	5.24	5.00	2.91
Others	5.94	6	3.08	Microsoft FrontPage	3.46	3.00	2.77

*Stars Rating scale = 1 (Never used) to 10 (professional user)

Following this question, students reported on their skill levels on using other authoring tools, ‘Others’, and gave examples of these tools. Eighteen students responded to this part of the question, and provided 18 different tools. The average of their skill levels on using these tools was 3.93 (median 3, STD 3.24). The ‘Others’ tools included:

- Programming tool (4 tools)
- Design tools (4 tools)
- Music and movie generation applications (3 tools)
- eLearning development tools (2 tools)
- Content management systems (2 tools)
- Project management application (1 tool)
- Reporting and statistical application (1 tool)
- Presentation application (1)

Student responses on their competencies and skills using common and advanced content authoring software tools showed that the more the student is skilled in using different content authoring tools, the better the quality of generated learning resources that the student is capable of producing. Similar to data analysis for this part of the survey in Cycle 1, the mean for student skill levels on using common content authoring software tools was higher than their skill levels on using advanced tools.

Additionally, for common tools and advanced content authoring software tools, the means of skill levels of each group were set as thresholds (i.e. mean of common tools = 5.7, mean of advanced tools = 3). The threshold for each category was used to compare student marks in the projects for each category.

Based on sample size of 74 students, for those who attempted the survey and submitted their projects, correlation analysis was conducted to verify the relationship between the two variables, and to help answer the same research question 1.1. Similar to the outcome of Cycle 1, data analysis showed that the more skilled a student is in using content authoring software tool, the better the mark, resulting in better quality student-generated learning resources. However, the correlation analysis based on PPMCC determinant (r2) between the paired scale variables ‘students skills in using advanced content authoring software tools’ and their ‘marks’ in generating learning resources was -0.07, which indicated a weak negative linear relationship between the two variables. On the other hand r2 was 0.14 for correlation between ‘common content authoring software tools’ and ‘marks’ and r2 was 0.18 for correlation of ‘all tools’ and ‘marks’, which represented that 18% of student performance can be explained due to their skills levels in using content authoring software tools as there is a positive relationship, however, a weak one.

This part of the findings showed that students came to their classroom with very basic skills in using content authoring software tools, therefore, even though the relationship between the two variables was weak, scaffolding students with technical training on using advanced content authoring software tools helped to improve their technical skills in the OER development process. Additionally, the ‘Student as Producer’ initiative assumes that students bring technology as a norm to their classroom (Winn & Lockwood, 2013), however, if students are not taught how to repurpose their skills in meaningful ways, their skills will remain basic and mostly will not help to improve their learning performance. In a word, the assumption of having university students bring technology to their classrooms as a norm is unlikely to be valid in all cases. Therefore, technical scaffolding is essential in the design principles of the OER development model.

4. User-generated content

The investigation of student experience in user-generated content continued in this part of the survey. Using the same set of 19 activities from Cycle 1, this part of the survey helped in collecting additional data to verify the correlation reported in Cycle 1 between previous experience with user-generated content activities and their marks in the projects. Importantly, similar to Cycle 1, the correlation test contributed to answer the research sub-question 1.2.

EFA was used to cross validate the factor structure identified in Iteration 0, as well as employed on the new dataset of the sample of study for this part of the survey consisting of 110 responses. The analysis was performed by means of PCA with Varimax rotation. Student responses showed a similar pattern of falling into three factor solutions of the same part of the survey of Cycle 1, as responses showed that they are active on personal activities (mean 2.96, STD 0.63) more than communal activities (mean 1.98, STD 0.47) and public activities (mean 1.45, STD 0.26).

However, in this part of the survey, using PPMCC, student responses showed a weak negative relationship between student responses to user-generated content activities and their marks in the projects, where the determinant (r2) was 0.12. The weak negative relationship also emerged among all groups of activities, where r2 resulted to 0.15 (public), 0.46 (communal) and 0.75 personal activities respectively. Interestingly, there is a strong negative relationship between communal and personal activities and student marks. Student engagement with communal activities (such as rating products online, creating presentations, creating and managing databases, adding product review comments, creating graphics and writing documents) and personal activities (such as sending SMS, uploading digital camera photos, using social networking websites and uploading mobile photos) appeared to have a negative effect on the quality of student-generated learning resources. Hence, the more the students engaged in personal and communal online activities, the less their performance in delivering good quality student-generated learning resources.

The correlation between student engagement in public activities and their marks appeared to have a linear relationship, as in Cycle 1 and Cycle 2. However, for public activities labelled in the factor analysis, student engagement in this type of activity was poor. Therefore, a lack of engagement of students in online activities that have public values needs to be further investigated in-depth. Importantly, investigating whether students are actually creating content that have important value but not sharing their work on the internet. Shirky (2010) has argued that people can transform online activities that have personal and communal values to activities that have public and civic value by sharing these activities on a wider scale.

Therefore, understanding the sharing behaviour of online activities that students do in user-generated content can provide a deeper understanding of their actual experience in user-generated content. Further investigation can lead to a clearer answer to research question 1.2, and identify the types of user-generated content activities that students are engaged in. Importantly, as the OER development model encourages students to create and share their student-generated learning resources, investigating students sharing behaviour of user-generated content can help to justify their sharing behaviour of student-generated learning resources.

Finally, the students were asked if they have created user-generated content in their free time. The response rate was 95% of the group, with 42% (n=46) stating ‘Yes’ and provided 82 examples of their user-generated content. The content types included photos collections, YouTube clips, websites and personal profiles. Publishing user-generated content given by the students was 44% (n=36). Among the 82 examples, 23 students claimed that their content was learning resources that could be used as learning resources. However, none of the links provided or contained genuine learning content. This finding indicated a lack of understanding that students had about what constitutes a learning resource, as well as a lack of awareness of the instructional design of online content that can be used as learning resources. Therefore, further support in the instructional design of learning resources is a required skill for students in the OER development process and needs to be addressed in the following iteration of the research.

5. *Incentives to create and share*

Students were asked about their incentives to create and share digital content on the internet by ranking a set of incentives, where 0 means ‘Not an incentive to me’ and 100 means ‘This is a strong incentive to me’. The completion rate of this question was 39% (n=43).

As in Figure 6.4, the responses varied about what would make strong incentives for students to participate in their user-generated content, however, they considered that ‘Being connected with others’, ‘Sharing knowledge’, ‘Help others learn’ and ‘Autonomy and ownership of work’ are the top incentives. These incentives were also found in other studies that investigated incentives behind creating and sharing user-generated content (Deci, Koestner, & Ryan, 1999; Kirkwood, 2006; Pink, 2009, 2010; Shirky, 2010). Students ranked the incentive ‘Being connected with others’ as the highest incentive for them to create and share online content. They appeared to maintain their social life through user-generated content activities in the online environment. Even though new technologies have established wired barriers that limit social life practices, new generations have maintain their need for social networking through online practices.

There is also a concern in this part of the survey where students were less motivated to participate with their user-generated content in a formal educational context as they ranked ‘Academic publishing’ and ‘Building their portfolios’ among the least incentives for them to create and share user-generated content. In Cycle 1, students showed a low rate for creating and sharing student-generated content. This low rate can be related to their poor incentives to create and share for academic purposes. This result is also reflected in the following section, where student-generated content has been rarely tapped into.

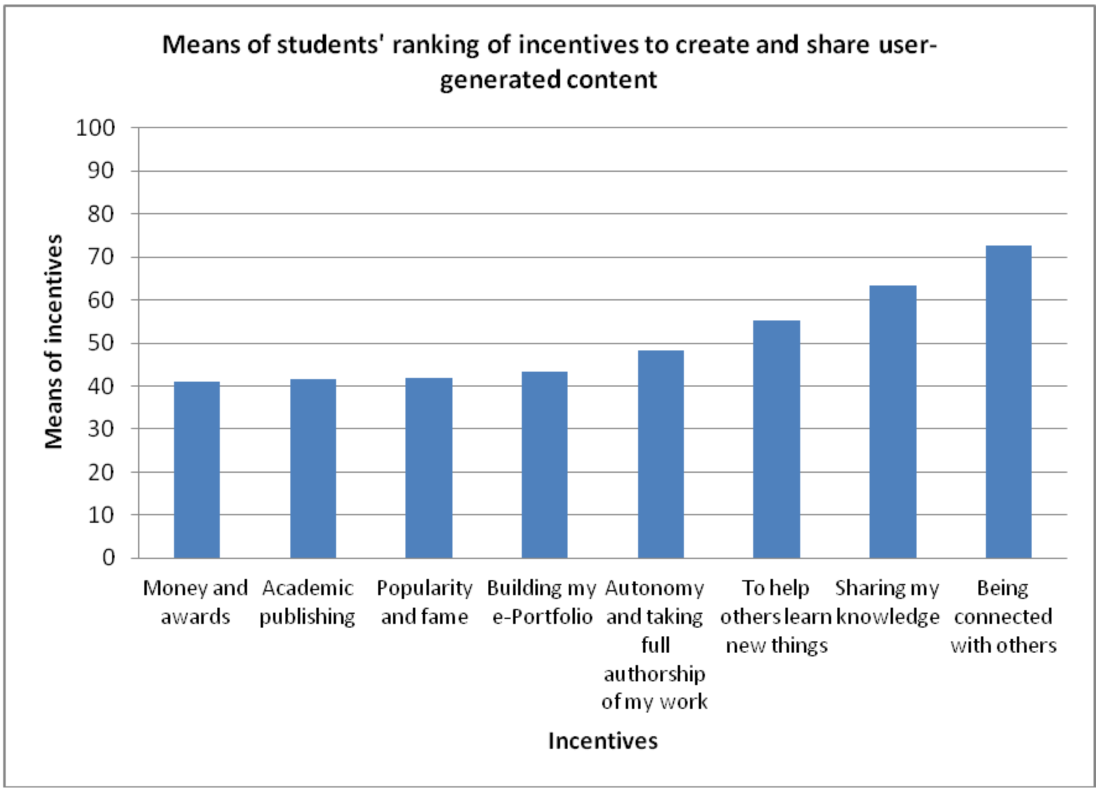


Figure 6.4: Incentives to create and share user-generated content – Cycle 2

6. *Student-generated content*

The final section of the survey collected data about student-generated content, which are the types of digital content that students generate inside their classrooms for educational purposes. Students were asked:

> *Have you created digital content before in any of your study units for educational purposes, for example projects, assignments, presentations, documents or any kind of digital content?* (Appendix E)

Twenty-eight (25%) students replied positively and gave 28 examples, 67 (61%) replied negatively, and there were 15 missing values where students had not completed this question. Similar to Cycle 1, in Cycle 2 of the research there was no online publishing of student-generated content.

Bull et al. (2008) raised the concern of the abundance of student online activities that are taking place in informal setting, and that there is a need to connect informal online activities with formal educational context through collaborative work between educators and students.

Student-generated content can be a dynamic area for raising such collaboration and connecting between the informal learning that students do in online activities and formal educational context. However, bridging formal and informal learning can be challenging unless there is a strong incentive for students to participate in creating content collaboratively with their teachers and sharing the content openly on the internet.

Cycle 1 and Cycle 2 of the research showed that students are engaged more with personal and communal activities than public activities, which indicates that sharing behaviour, if conducted on a wider scale, can result in better benefits for students and other users. Hence, tapping into student-generated content can be more feasible if students share their content openly on the internet.

6.4.4 Cycle 2 of Iteration 1: Outcome

Cycle 1 of Iteration 0 helped to evaluate the proposed OER development model in a real life educational environment and assess how well its main components worked together. From this initial evaluation of the model, the following modifications were carried out to the next cycle:

1. **Academic background of students:** Performance of students at the School of Health and Science were slightly higher than the rest of the sample, including students from the SCEM. This result has also been replicated from Cycle 1 of Iteration 0.

2. **Technical scaffolding for students:** Learning resources (30%) collected in Cycle 2 were content based and lack interactivity. Therefore, technical scaffolding for students on using content authoring software tools provided interactivity and facilitated embedding multimedia. Additionally, in the data analysis of Section 6.4.3.2 of the online survey, students reported that they are skilled in using common content authoring software tools, however, their skills in using advanced content authoring software tools were reported as basic. This lack of competency was not unexpected, although it revealed important need to provide students with training on using advanced tools that are easy for them to understand and a medium for embedding multimedia content, which can help them with generating quality learning resources to which students can transfer their skills in using common tools into one advanced tools. In this stage, using wiki to develop student-generated learning resources is recommended for the next iteration. However, providing

technical training is essential. In discussing the use of Web 2.0 by students, Vassileva (2009) argued that students currently look for easy-to-use technology that does not require them to think about complicated software. Therefore, the digital generation is looking for simplicity. The author also suggested that due to a proliferation of interactions and mash-ups of Web 2.0 technologies that empower software developers, new standards should grow but need to be simple so they can be followed (Vassileva, 2009).

3. **Instructional design to support students with developing the learning resources:** None of the learning resources developed by students during Cycle 2 was structured, and there was a lack of proper implementation of instructional design among all student-generated learning resources. Additionally, data collected from the online survey showed a lack of understanding that students had about what constitutes a learning resource. This led to important modification of the design principles of the proposed OER development model on scaffolding students, namely, providing them with directions on structuring the learning resources.

4. **Introducing the teaching team to the OER development process:** As the OER development model was new to the learning environment, preparing the teaching team to integrating the model into the curriculum was essential. As expertise varied among the unit coordinators, preparing the teacher with adequate understanding of the OER development process was essential support to the students to be provided. In addition, the teaching team was to maintain awareness of the benefits of OER in higher education.

5. **Evaluating the learning resources:** The quality criteria used in assessing the learning resources evaluated the technical aspect of the content. However, for learning resources to be shared openly with other learners, the educational content must be evaluated. In addition, as learning resources are to be published as OER, the openness aspect needs to be evaluated as well. Therefore, a new set of quality criteria that evaluate the technical, educational and openness aspects of learning resources generated by students needs to be developed and integrated with the teaching unit learning guide.

6. **Digital skills of students:** Even though students reported spending an average of five hours 27 minutes online daily, and that they perceive themselves as competent users

of new ICT, data analysis showed that they are highly engaged in online activities as personal and communal, such as social networking activities. However they are less active in public activities, such as creating wikis and blogs. This result of low engagement of students in productive activities aligns with previously published research by Kennedy et al. (2010) that explored the types of technology users in a sample of 2,096 students aged between 17 and 26 years from three Australian universities, which represented the same age group in this thesis. The study identified four distinct types of technology users: (i) basic users (45%); (ii); power users (14%); (iii) ordinary user (27%); and (iv) irregular users (14%). Nonetheless, the engagement of students in user-generated content activities has wider benefits, for instance, creating videos for educational purposes can support a rich and authentic learning experience, encourage students to take ownership of their learning, and provide an opportunity for students to share their work with a wider audience (Kearney et al., 2012). Hence, maximising learning responsibilities for learners by engaging them in productive activities inside the classroom requires pedagogically driven innovations.

7. **Establishing incentives to create and share OER:** The four key incentives for students to participate in user-generated content were: (i) being connected with others; (ii) sharing knowledge; (iii) helping others learn; and (iv) maintaining autonomy and ownership of work. These incentives were also found in other studies that investigated incentives behind creating and sharing user-generated content (Deci et al., 1999; Kirkwood, 2006; Pink, 2009, 2010; Shirky, 2010). Therefore, engaging students in generating learning resources needs to be harnessed through establishing the same intrinsic incentives.

6.5 Phase Four

Reflection on the implementation of research and documentation of Iteration 1 continues in Phase Four. The updated design principles of Phase Two in Section 6.3 were modified based on the outcome of model implementation in Cycle 2 and carried out to the last iteration of the research.

As Iteration 1 marks the growing stage of the OER development model, the engagement of the ‘Introduction to IT’ unit for another iteration helped with maintaining the model with the unit curriculum and having a group of teaching staff who are aware of the OER development process. Additionally, a diverse group of students from different academic backgrounds helped with better understanding the implications for different learning environments. Therefore, further improvements can take place to the OER development model, and guidelines for students and teachers can be designed based on the outcome of the iteration.

One important recommendation of Iteration 1 was a need to engage new study units in the research. Cycle 2 revealed that it was difficult to assess the accuracy of the learning resources as students enrolled in the ‘Introduction to IT’ unit were from different academic backgrounds, and the topics of generated learning resources were selected autonomously by students. Assessing educational content accuracy was very challenging for the teaching team because their academic background in the computer science or information technology areas differed. Hence, there was a need to engage new participants in the research where the learning resources could be developed based on the unit topics. This can eliminate the autonomously of selection of topics, but unless learning resources accuracy is adjusted and free from error, it cannot be published as OER. The engagement of new participants also required extending the invitation to other units in the SCEM.

6.6 Summary

Chapter Six presented Iteration 1, the growing stage of the research reported in this thesis. The structure of the chapter aligns with the four phases of the DBR methodology as in Chapter Five. The theoretical framework of the research continues to embrace the term of digital natives, as presented in Phase One. However, it is learned from previous research that learning environments advance student digital competencies rather than having digital generations with sophisticated ICT skills (Gros Salvat et al., 2012). Additionally, the claim of digital natives is related to enthusiasm of the younger generation in using ICT in their daily life. Phase Two resumed modifying the design principles based on the previous iteration and extended literature review to produce a modified set of the design principles of the proposed model. Phase Three carried out the modified design principles, showed details of Cycle 2 and revealed new areas that required further modifications over the following iteration of the research. These areas were explained in the set of outcomes of Cycle 2 and included: (i) the need for developing a new set of evaluation criteria to assess the learning resources; (ii) providing students with technical scaffolding in using content authoring software tools; (iii) supporting them with instructional design of the learning resources; and (iv) the need for engaging new participants in the research. Phase Four concluded Iteration 1 by highlighting the documentation process that took place at the end.

A recommendation from Iteration 1 has been carried out to Iteration 2 to allow for new participants and further modifications that will enhance the final design principles of the OER development model.

Chapter Seven:
Adapting stage of the open educational resources development model – Iteration 2

7.1 Overview

In this thesis, the design solution of the OER development model was proposed to respond to OER challenges and to answer the research questions. The research in this thesis has been guided by DBR methodology, which makes the nature of the research of iterative characteristic in the design, implementation, analysis and refinement (Design-Based Research Collective, 2003). In Chapter Five, the starting stage (Iteration 0) of the research took place and initial design principles were proposed. The recommendations from Iteration 0, which represent the feasibility of the model and the initial solution, were carried out in the growing stage (Iteration 1), as presented in Chapter Six. These recommendations were also used to refine the OER development model and integrate the model in the learning environment. Outcomes of the growing stage were significant for the last iteration in the research. The adapting stage of the OER development model is presented in this chapter, in which the final design principles and outcomes were generated and presented at the end of the chapter. Figure 7.1 presents a summary of the adapting stage.

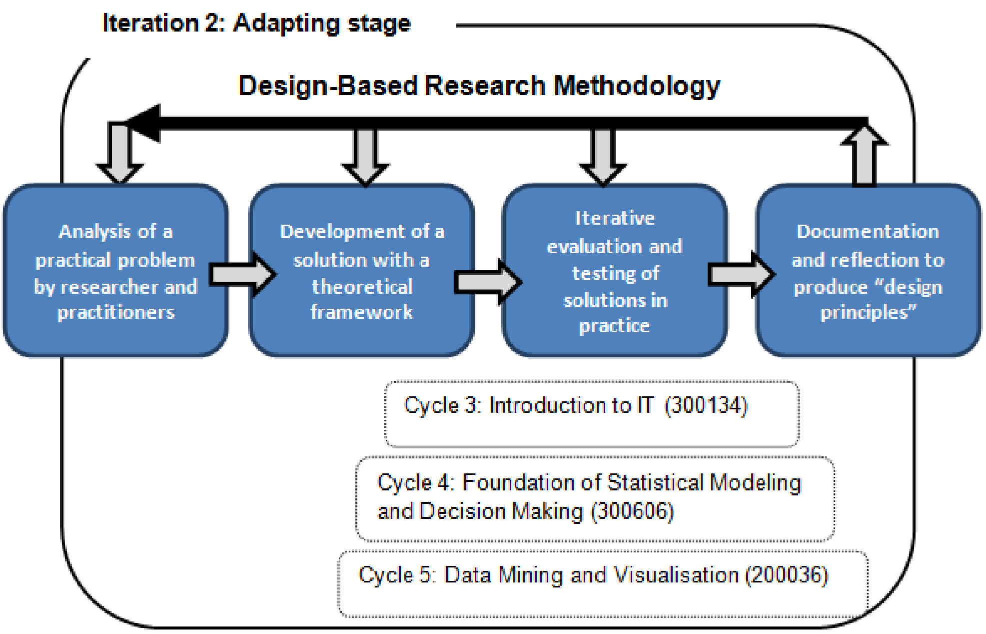


Figure 7.1: Adapting stage of the OER development model

As presented earlier in Section 3.2, Shirky (2010) explained that to create a community in which people can participate and share their work, the environment must allow them to act and be part of the environment before enforcing rules. Therefore, moving from the starting stage (Iteration 0) to the growing stage (Iteration 1) and eventually to the adapting stage (Iteration 2) required understanding of the interaction of students and teachers with the OER development model and its gradual integration in the curriculum design of the study unit before setting the final design principles of the model. For example, publishing student-generated learning resources was a critical issue to the model integrating in the learning environment, as the teacher can take on joint authorship of the work. Joint authorship is then specified internally by the teacher and students as it is dependent on the actual contribution in the OER development process.

The following sections in Chapter Seven present four phases of the final iteration of the research in this thesis, followed by Chapter Eight where the final design principles of the OER development model are presented, discussed and recommended.

7.2 Phase One

In Phase One of Iteration 2, invitations were sent to five unit coordinators in SCEM (Appendix A). A positive response was received from the 'Foundations of Statistical Modelling and Decision Making' (300606) and 'Data Mining and Visualisation' (200036) units to join the research during the academic semester August to November, Spring 2013. The newly selected unit coordinator managed both units.

Collaboration in Phase One took place through meetings with the new unit coordinator confirmed that student-generated content has rarely been tapped into. He also emphasised that there is a need to repurpose student projects in a way that engages students in their learning and improve their learning performance.

> *"On every semester that this unit is offered, students are required to develop portfolios consisting of examples that demonstrate the use of statistical theories. Mostly these portfolios are handwritten; however few students used word processors to build their projects. At the end of the semester these projects are usually stacked in the office for several years but never tapped into."* (Unit coordinator of Foundations of Statistical Modelling and Decision Making, Spring 2013)

Hence, evidence of surplus student projects that were generated in every semester that had been rarely tapped into is an area that requires further exploration and understanding in higher education. In addition, adopting the project-based learning approach and a lack in utilising content authoring software tools, particularly in the ‘Foundations of Statistical Modelling and Decision Making’ unit, makes the learning environment adequate for integrating the OER development model.

The ‘Introduction of IT’ unit was also part of Iteration 2, as it provided a large group of participants for additional data to be collected that represented a better understanding of student skills in using new ICT to generate learning resources. Among the recommendations of the previous iteration, there was a need to provide further reflection on the role of the teacher in the OER development model. Hence, during Cycle 3 of Iteration 2, the researcher became more involved in the learning environment, and handled tutoring duties for the ‘Introduction to IT’ unit. Additionally, in Cycle 4 and Cycle 5, the researcher took the role of e-learning facilitator for the development of learning resources at the new participating units.

Phase One also continued with exploring related areas in the OER literature. With recommendations of Iteration 1, there was a need to adjust the pedagogical framework of the learning activities of the OER development model. In addition, Iteration 1 raised an urgent call to develop a comprehensive evaluation criterion of the learning resources generated by students, and that the criterion must consider, not only a technical perspective, but also educational and openness perspectives of the learning resources.

Figure 7.2 presents the extended literature review. The following sections extend on the growing literature review in this thesis and present the role of the learning theory in the OER development model with a focus on constructivism in higher educational environments, and then move forward to discuss evaluation criteria of learning resources with a focus on student-generated learning resources. The last part of the literature review discusses the diffusion of innovation theory, a theory used to explain the attitude of the unit coordinators towards creating and sharing learning resources and justifying the acceptance of the OER development model in the learning environment.

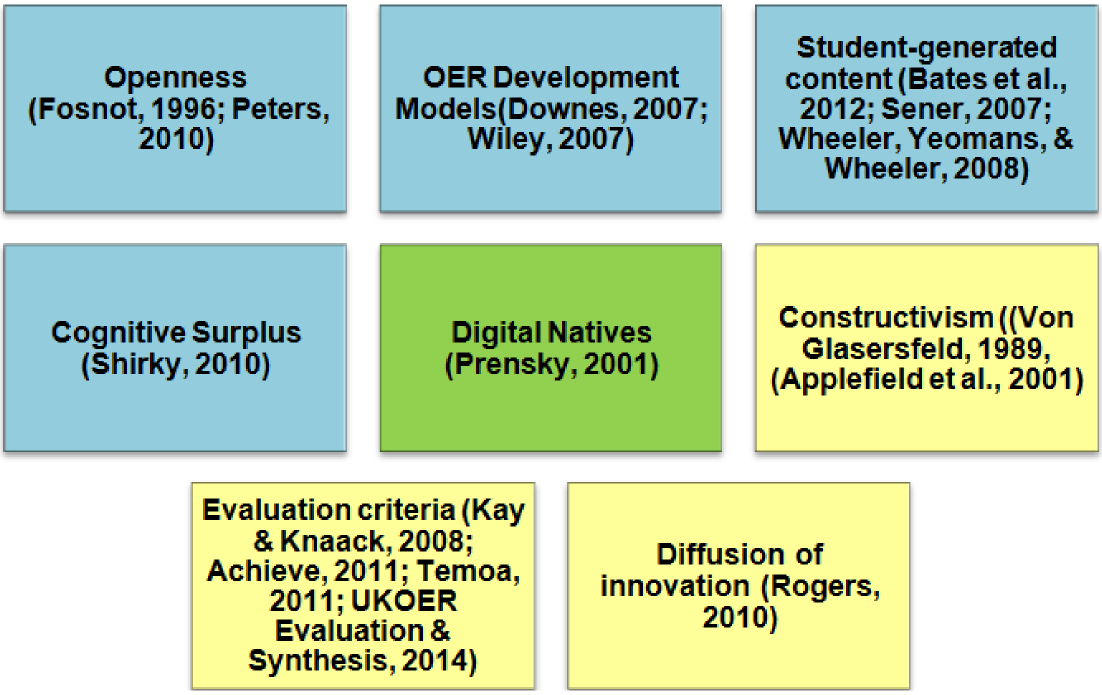


Figure 7.2: Phase One – Iteration 2: Extended literature review map

7.2.1 Role of learning theory in the OER development model

This section explains how learning theory of constructivism provides a pedagogical framework for the proposed OER development model, presents a brief introduction of constructivism and explores the implications of constructivism for adopting the OER development model in the undergraduate learning environment. During Iteration 1 of the research, there was a need for clear definitions of learning activities of the OER development model. Therefore, in order to clearly define these activities, analysis of the existing literature of learning theory associated with the learning activities of the OER development model was determined.

Previous research of constructivism showed the effectiveness of applying constructive learning activities in TELE (Al-Huneidi & Schreurs, 2013; Ally, 2004; Grabowski, 2009; Wang & Hannafin, 2005). Human learning and educational systems witnessed a significant paradigm shift from objectivism learning theories of behaviourism and cognitivism to an epistemological view of knowledge construction mainly in the introduction of the constructivism (Applefield, Huber, & Moallem, 2001). The constructivism theory finds its roots in the work of Jean Piaget in cognitive development theory (Piaget, 1976), and is based on the areas of psychology, philosophy, science and biology (Youniss & Damon 1994; Von Glasersfeld, 1989). The theory is explained in the work of Fosnot and Perry (1996) as it describes knowledge as emergent, developmental, non-objective, viable constructed explanation by human engaged in meaning-making in cultural and social communities of discourse.

In constructivism, learning is a constructive activity in which learners take ownership and responsibility for their own learning and interpret the world according to their personal reality rather than being passive knowledge receivers. Teachers facilitate, coach and monitor learning by creating opportunities and incentives (Von Glasersfeld, 1996) and making on-the-spot decisions that require skilful, reflective and spontaneous actions.

According to Von Glasersfeld (1989), the most accepted principles in constructivism are:

1. Knowledge is not passively received but actively built up by the cognising subject.

2. The function of cognition is adaptive and serves the organisation of the experiential world, not the discovery of ontological reality.

Applefield et al. (2001) cited Moshman (1982) in identifying three types of constructivism including:

1. *Exogenous constructivism* suggests that the learner’s mental structures develop to reflect the organisation of the world.

2. *Endogenous constructivism or cognitive constructivism* is knowledge constructed internally in mental processes as learners assimilate new information to existing knowledge through modifying it to fit their intellectual framework. Conole (2008) showed that the main focuses of cognitive constructivism are on the processes by which learners build their own mental structure when interacting with an environment, and being a task oriented theory that favours hands-on, self-directed activities orientated toward design and discovery.

3. *Dialectical constructivism or social constructivism* emphasises the social construction of knowledge and describes learning in knowledge construction as human interactions with the world around where the reality is found in social context and through actions.

In the proposed OER development model, the learning activities are of a constructive nature that support active knowledge generation through a project-based learning approach as the model engages students and teachers in generating learning resource processes such as building learning content (multimedia content), structuring it and developing learning exercises to improve interactivity. These constructive activities require collaboration from students and teachers to help with adjusting accuracy and the instructional design of the learning resources being developed. Hence, the theory of dialectical constructivism or social constructivism has informed the integration of the model in real life educational settings through establishing communities of practice of students and their teachers in the OER development as part of the learning process.

Still, there are significant implications for using constructivism in the context of the OER development process as part of student learning. The following points show how this paradigm brought the practice of integrating OER development model into undergraduate learning environments:

1. Personalised meaning of the constructed knowledge and active learning processes (Ally, 2004) was maintained by engaging students in developing learning resources based on study topics required them to develop comprehension of the topics to be able to reconstruct it as learning resources. Therefore, creating personalised meaning of knowledge allowed students to build their own understanding of what is being perceived of knowledge and to develop learning resources that can be reused by other learners.

2. Knowledge was constructed based on what learners understood, rather than accepting what was instructed by the teachers (Ally, 2004). The students went beyond consuming knowledge and the cognitive processing of information to an area where they developed learning resources. In the OER development model, teachers facilitated the process with guidance on learning design principles and educational accuracy of the learning content.

3. Learning took place in a real world setting (Applefield et al., 2001) where students engaged in building learning resources through using Web 2.0 technologies that allowed them to build learning resources and publish on the internet as they engaged in the development process of the content.

4. Evaluation was carried out as part of the task (Ally, 2004; Applefield et al., 2001). Students received feedback from their teachers, peers and online viewers during the development of learning resources.

5. As facilitators of the learning process, the teacher's role is to engage with students (Von Glasersfeld, 1987). Using new educational technology tools, teachers facilitate the learning process that happens in synchronous and asynchronous media (class discussions, emails and discussion forums). These tools are important to facilitate the communication in the OER development process as teachers help with adjusting the learning resources for all students and share the feedback they provide among the whole group by using asynchronous communication media, such as the discussion forums of the learning management systems.

The above five implications of constructivism underpin the pedagogical framework of the OER development model. Each of the above implications has a specific part in informing the integration of the OER development model within a study unit. In addition, there are benefits that can be realised in the learning outcome. For example, maintaining an active learning process is implemented in publishing learning resources where learners get the opportunity to receive online feedback from other learners.

7.2.2 Web 2.0 tools as enabler of constructive learning

The introduction of ICT created a high demand on investigating the impact of learning theories and these technologies on the learning process. Grabowski (2009) argued that throughout the history of instructional design in the lenses of learning theories and with the introduction of ICT in learning and teaching, there were cycles of satisfaction and disappointment to the learning process. She referred the disappointment to the failure of these technologies to engage learners and the incompleteness of the learning theories. However, she showed that the current age of Web 2.0 technologies and ubiquitous computing have brought a degree of satisfaction to the learning process as these technologies meet with the learning needs as defined by the social constructivism. Web 2.0 tools also led to the engagement of learners and experts in the learning process, and the idea of co-creating the knowledge as defined by the social constructivism that brought promise to the theory of instructional design on improving the learning for the current generation.

As presented Chapter Five in Section 5.2.3, the learning environment has adopted Web 2.0 for learning and teaching, as these tools help to facilitate active learning and provide students with the opportunity to participate in collective and collaborative learning activities such as student-generated content. The wide proliferation of the internet and Web 2.0 tools has encouraged multimedia content creation, and adopting these tools as part of the learning design can lead to effective constructive learning. Higher educational institutions are adopting the use of Web 2.0 technologies to develop student awareness, attitude and ability to efficiently use digital tools to identify, access, manage, integrate, evaluate, analyse and synthesise digital resources, construct new knowledge, create media expressions and collaborate with others (Martin, 2006). Web 2.0 and the ubiquity of computing mediate communication, co-construction of knowledge, feedback and reflection from different users and expertise (Grabowski, 2009). However, Gráinne Conole (2008) argued that we need to see how Web 2.0 tools can be utilised to get the best effect of fundamental learning characteristics. Additionally, Huang et al. (2013) raised the concern that little empirical research is documented on the effects of Web 2.0 tools on learning.

In the OER development model, Web 2.0 tools work as enablers of constructive learning activities where students use these tools to build learning resources based on previously constructed knowledge and their understanding of particular topics during their study. Constructivism emphasises the role of students as active knowledge constructors and teachers as facilitators of knowledge construction through the learning process. The use of Web 2.0 tools in developing learning resources helps to mediate knowledge construction, however, measuring the learning performance through assessing the quality of learning resources can help in providing empirical evidence of the tangible results of the effect of Web 2.0 on learning outcomes.

7.2.3 Evaluation criteria of student-generated learning resources

Previous research proposed a number of approaches to evaluate the quality learning objects supported by empirical evidences. These approaches focused on different criteria, such as reusability of learning resource (Sanz-Rodriguez, Dodero, & Sanchez-Alonso, 2011) and quality of the learning design and instructional content of learning resources, as well as the ability of learning resources to engage learners in the learning process (Becta, 2007; Kay & Knaack, 2008; Nesbit, Li, & Leacock, 2005). There are also evaluation criteria models that were developed to assess the quality of OER. For example, Vladoiu and Constantinescu (2013) provided a model that emphasised the evaluation of content, instructional design and technology-related aspects of OER. Additionally, a comprehensive evaluation model of OER was designed by Achieve. Achieve is an American non-profit organisation concerned with developing academic standards and assessment benchmarking for educational organisations. It developed a set of rubrics to assess the quality of OER that assesses the degree of alignment to standards, quality of explanation of the subject matter, utility of materials designed to support teaching, quality of assessment, quality of technological interactivity, quality of instructional tasks and practice exercises, opportunities for deeper learning and assurance of accessibility (Achieve, 2011).

The majority of the existing evaluation models of learning objects and OER were designed by academics, instructional designers and e-learning teams. These models served to assess the quality of learning resources that were generated by a group of professionals. Even though several efforts were made on proposing quality criteria that assess quality of learner-generated content (Pérez-Mateo et al., 2011), these criteria assessed content rather than the structure of learning resources, which requires careful implementation of the instructional design. In addition, no practical evidence existed of integrating the quality criteria as part of the learning assessment. Hence, there is a need to develop a set of quality evaluation criteria that can be used to evaluate student-generated learning resources that students develop through the learning process.

Additionally, even with available detailed instruments that were designed to evaluate learning resources (Kay & Knaack, 2008) and OER (Achieve, 2011; Temoa, 2011; UKOER Evaluation & Synthesis, 2014), these evaluation sets of criteria may not be suitable for evaluating openness in learning resources that is significant for creating OER. For example, the use of open publishing licences and currency of learning resources are important aspects of OER, as openness of learning resources indicates the flexibility of content to evolve though reusability and contributions of others, and therefore need to be evaluated in an explicit manner.

In context of the OER development model that is proposed in this thesis, learning resources are generated by students and teachers as facilitators of the development process. Engaging teachers as co-creators of the learning resources can help learning content accuracy and ensure alignment of learning resources to principles of instructional design. However, the outcome of the development process needs to be adjusted by means of evaluation criteria, which needs to be available for students in advance as they generate the learning resources.

In this section, a new set of evaluation criteria is developed to assess the technical, openness and educational aspects of student-generated learning resources and how they relate to OER. The major contribution of the evaluation criteria can be seen from two angles. ***First***, it is designed to assess learning resources designed specifically by undergraduate students as part of their learning process; as well as professionals such as educators and educational technology specialists. As inexperienced teachers, students generally lack previous experience in generating learning resources, especially with meeting instructional design standards. Therefore, the proposed evaluation criteria in this section were designed to help students in improving the main aspects of learning resources by focusing on reusability and educational accuracy of the content. However, it must not be assumed that simplicity compromises the quality of learning resources, but rather considers the capabilities of students as young content developers. Additionally, the criteria were simplified to serve as guidance for students during the development of the learning resources and help with measuring the fitness of student-generated learning resources to OER.

Second, the evaluation criteria addressed the importance of assessing the openness dimension of a learning resource as a substantial feature of OER. An openness criterion has not been well addressed by existing OER evaluation criteria as OER are treated equally with learning objects in most cases. In the context of the OER development model, embedding OEP is important to the learning process, particularly with adopting communities of practice that enable students and teachers to benefit from collaborative development of OER. Hence, for these benefits to be realised, generating open content by associating it with open publishing licences facilitates its reusability by future students and opens up new opportunities to maintain communities of practice around OER development. Therefore, explicit identification of openness criteria in student-generated learning resources signifies the importance of the content and assesses its fitness to OER.

Table 7.1 represents a summary of quality criteria used to evaluate student-generated learning resources. The set of criteria was used by students as a reference during the development process of the learning resources. Teachers also used the criteria to provide feedback on the quality of student works. Table 7.1 consists of three dimensions: (i) technical; (ii) openness; and (iii) educational, where each dimension summarises the sub-criteria. Following Table 7.1 are detailed explanations of each criterion based on the literature review.

Table 7.1: Evaluation criteria of student-generated learning resources

Technical	**Design and presentation**	*Graphical user interface*
		Interactivity
		Navigation
	Reusability	*Interoperability*
		Decomposable
		Cohesion
		Granularity
Openness	**Availability**	*Open licence*
		Aliveness
	Community of practice	*Trust (learner/teacher)*
Educational	**Content**	*Accuracy*
		Exercises to support learning
	Structure	*Motivation*
		Alignment to learning objectives
		Referencing

Technical: The technical dimension evaluates proper illustration of using features of content authoring software tools to deliver functional learning resources. The technical illustration of use assesses design and presentation, and reusability of learning resources. Under each criterion are sub-criteria that assess detailed features of learning resources. The list of sub-criteria can be more convenient for students because this division helps them pay attention to details during the development process. Graphical user interface, interactivity and navigation are important criteria that assess design and presentation (Becta, 2007; Kay & Knaack, 2008; Kurilovas, Bireniene, & Serikoviene, 2011; Leacock & Nesbit, 2007; Temoa, 2011).

1. **Design and presentation:** This criterion is related to aspects of the appearance of the content, accuracy of the responses to learners' actions and ease of navigation throughout the learning resources.

i) *Graphical user interface:* Level of consistency of using font, colour and images, and the efficacy of integrating graphics, text, video and audio media in learning resources (Alsagoff, 2012; Kurilovas et al., 2011; Leacock & Nesbit, 2007). The criterion also describes the quality of graphics, consistency of layout, labelling and readability (Kay & Knaack, 2008).

ii) *Interactivity:* Ability of learning resources in promoting constructive activity, providing a user with sufficient control and level of interactivity. The criterion also indicates the use of rich activities throughout the content that provide opportunities for learners to explore new ideas, develop personal meaning making and integrate knowledge (Brown & Voltz, 2005; Kay & Knaack, 2008).

iii) *Navigation:* The criteria navigation and usability are used interchangeably in many works referred to in the literature review. The criterion refers to the ease of navigation of the learning content presented in the resource, mainly represented in its structure and response to the user's actions. The design of the user interface implicitly informs the user how to interact with the resource and provides clear instructions. It also has a consistent and predictable response to that learner's actions that are not confusing and free from errors (Kay & Knaack, 2008; Leacock & Nesbit, 2007; Temoa, 2011).

2. **Reusability:** The concept of reusability refers to the degree to which a learning resource can work efficiently for different learners in different digital environments and in different educational contexts over time (Sanz-Rodriguez et al., 2011). This feature is usually found in the area of object oriented programming in computer science, from which the term 'learning object' has been derived (Wiley et al., 2000) and used interchangeably with OER (Andreatos & Katsoulis, 2012). Therefore, evaluating the reusability of student-generated learning resources requires assessing different aspect of reusability interoperability, decomposability, cohesiveness and granularity. Kurilovas and Serikoviene (2013) described the reusability criteria from a pedagogical perspective rather than a technical one, and identified three elements of reusability; (i) interoperability; (ii) flexibility in pedagogical context; and (iii) modifiability to suit learner and teacher needs. However, this can be a confusing measurement for evaluators as reusability is a technical term originated in object oriented programming. Additionally, the importance of reusability criteria for the

adaptation of OER has been argued by Hilton, Wiley, Stein and Johnson (2010) who postulate that to adopt OER, developers of OER need to seek permission to use the resources of others by providing them with the technical means to unlock the learning resources.

i) *Interoperability:* The learning resource works across various platforms, browsers and existing learning management system without the need for additional software (Andreatos & Katsoulis, 2012).

ii) *Decomposability:* The learning resource is flexible, to be decomposed into its basic components, for example, script, text, diagrams, images, charts, tables, audio, narration and video components can be easily extracted separately (OERTN, 2009).

iii) *Cohesiveness:* The learning resource encapsulates all information and learning material in the same learning resource without referring to external resources.

iv) *Granularity:* The criterion refers to sub-components of a learning resource as the smaller the learning resource, the easier the reusability of that resource or part of it (Allen & Mugisa, 2010). Designing learning resources that are more granular and can be adapted into different context are more likely to be reused (Leacock & Nesbit, 2007).

Openness: Openness is strongly related to creating a learning resource that is flexible to be reused, revised, remixed and redistributed, and should be considered when creating OER (Hilton et al., 2010). The criterion can be defined by the availability of learning resources to be used, which indicates it has an open publishing licence and it continues to be alive. Openness can also mean it is reachable for the community of practice (Wenger, 2006), including teachers and learners.

1. *Availability:* The criterion can be described by the use of an open licence (e.g. Creative Commons) and the resource is up-to-date and continues to be fed by its authors.

i) Open licence: The learning resource is licensed with a flexible publishing licence (Kurilovas et al., 2011) and the least restrictive manner (e.g. by asking for attribution only).

ii) Aliveness: The learning resource continues to be current, alive and up-to-date by the original author or other contributors (OERTN, 2009).

2. *Community of practice:* Communities of practice are formed by people who engage in a process of collective learning in a shared domain of human endeavour (Wenger, 2006). The criterion is looking at group of learners and teachers, and the extent to which an individual trusts the content of a learning resource by providing personal perspective.

   Trust (learner/teacher): The teacher's trust is the level at which a teacher foresees the learning resource as a valuable learning resource that can be incorporated in a particular study unit. The learner's trust is the level to which a learner trusts the learning resource to contain correct and valid information to be used in critical times of study, for example, final exams (Pawlowski & Clements, 2013).

Educational: Educational criteria look at the learning resources content and its instructional design.

1. *Content:* This criterion includes the accuracy of learning material and quality of supporting material such as exercises.

   i) Content accuracy: The learning material is free from error and connects important associated concepts within the subject matter (Achieve, 2011). The content has a non-biased presentation of ideas, sensitivity to cultural and ethnic differences by using an appropriate level of detail (Leacock & Nesbit, 2007). The learning resource also provides comprehensive information effectively so that the target audience is able to understand the subject matter.

   ii) *Exercise to support learning:* This criterion applies to learning resources that provide an opportunity to deepen understanding, practice and strengthen specific skills and knowledge (Achieve, 2011). Some learning resources require more exercises while others need richer but fewer exercises (Achieve, 2011). Brown & Voltz (2005) defined a rich activity as one that provides learners with opportunities for action rather than directs them down a prescribed pathway. The quality of exercise also includes richness of exercises, integration of different skills, readability, free of errors and provision of answer keys.

2. *Structure:* The criterion evaluates motivation, alignment to learning objectives and referencing. This part of the evaluation criteria considers that content developers are students and not experienced teachers, therefore, the instructional design in this sense focuses of basic criteria rather than the complete set.

   i) Motivation is defined as the ability to motivate and interest an identified population of learners (Leacock & Nesbit, 2007). The resource has the potential to motivate and generate interest in the subject that is addressed, and offers a representation of reality-based content that could be through multimedia, interactivity, humour, drama and challenges through games that stimulate student interest (Kay & Knaack, 2008; Temoa, 2011).

   ii) Alignment to learning objectives, activities, assessments and learner characteristics require learning resource to provide content and activities appropriate to the goals and intended audience level, as well as match among assessments and learning activities (Leacock & Nesbit, 2007). Learning resource that verifies this criterion must state learning objectives at the early stage of the resource.

   iii) Referencing the criterion helps increase confidence in the learning content and allows learners to easily identify and locate original resources and evidence that the author of the learning resources has built links across knowledge, intelligent selection and analysis of previous work (Neville et al., 2012). This applies to learning resources that provide a complete references list at the end.

Table 7.2 is an extended version of Table 7.1, which elaborates on the evaluation criteria used to assess student-generated learning resources fitness to OER. Additionally, to help evaluators use the evaluation criteria, a Microsoft Excel file (Appendix I) was designed.

Table 7.2: Definitions of evaluation criteria

Quality Criteria	Definition	Sub-dimension	Dimension
Graphical user interface	The efficacy and proper level of consistency of integrating graphics, text, video and audio media.	Design and presentation	Technical
Interactivity	Ability of learning resource of promoting constructive activity, providing the learner with sufficient control, and level of interactivity.	Design and presentation	Technical
Navigation	Ease of navigation through the learning resource, mainly represented in its structure and response to learner's actions.	Design and presentation	Technical
Interoperability	The learning resource work across various platforms, browsers, and existing learning management system without the need of additional software.	Reusability	Technical
Decomposability	The learning resource is flexible to be decomposed into its basic components, for example script, text, diagrams, images, charts, tables, audio, narration, and video components can be extracted separately.	Reusability	Technical
Cohesiveness	The learning resource encapsulates all information and learning material in the same learning resource, without referring to external resources.	Reusability	Technical
Granularity	The relatively small size of a learning resource as the more granular the learning resource the more likely to be reused.	Reusability	Technical
Open licence	The learning resource is licensed with a flexible publishing licence in the least restrictive manner.	Availability	Openness
Aliveness	The learning resource continues to be alive and up to date by original author or other contributors.	Availability	Openness
Teacher's trust	The educator foresees the learning resource as a valuable learning resource that can be incorporated in a particular study unit. For example refer to it while teaching a related topic.	Communities of practice	Openness
Learners' trust	The learner trusts the learning resource to contain correct and valid information to be used as a main resource for learning or as a reference.	Communities of practice	Openness
Content accuracy	The learning material is free from errors and connects important associated concepts within the subject matter, has non-biased presentation of ideas, and provides comprehensive information effectively that the target audience should be able to understand the subject matter.	Content	Educational

Quality Criteria	Definition	Sub-dimension	Dimension
Exercises to support learning	The learning resource provides an opportunity to deepen understanding, practice and strengthen specific skills and knowledge. The criterion also includes richness of exercises, integration of different skills, readability, errors free and providing answers keys.	Content	Educational
Motivation	The ability to motivate and interest an identified population of learners and generate interest in the subject that is addressed, and offers a representation of reality-based content.	Instructional design	Educational
Alignment to learning objectives	Strong alignment among learning objectives, activities, assessments, and learner characteristics.	Instructional design	Educational
Referencing	Listing references and resources that were used to develop the learning resources.	Instructional design	Educational

The evaluation criteria is used for the first time in the adapting stage (Iteration 2) and recommendations of the design and use of the criteria are considered at the end of the stage in Phase Four.

7.2.3.1 Evaluation process of student-generated learning resources

Evaluating student-generated learning resources is the process that engages experts in assessing student-generated learning resources as outcomes of the OER development model. It is important to highlight that the evaluation process is part of the research iteration and the aim of the evaluation is to validate the reliability of evaluation criteria that is part of the OER development model. Additionally, engaging evaluators provided further feedback for the learning scaffolding that students need to improve their learning resources. Hence, a selected group of evaluators used the evaluation criteria to assess student-generated learning resources in the last iteration of the research. Selecting evaluators depended on the needs of the study and objectives of the evaluation (Kantor & Kendall-Tackett., 2000). As for evaluating student-generated learning resources, it was important to engage evaluators who are experienced in teaching the subject area of student-generated learning resources and generating online learning resources, with preferably knowledge in the concept of openness in higher education. The remainder of this subsection describes the process of selecting evaluators for the last iteration of the research.

Source of evaluators

Kantor and Kendall-Tackett. (2000) identified general advantages and disadvantages of hiring external and internal evaluators to evaluate a particular program (Table 7.3). The researchers associated the advantages and disadvantages to the needs of the study and the objective of the evaluation.

Table 7.3: Advantages and disadvantages of external and internal evaluators

External Evaluators		Internal Evaluators	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Objectivity	May need more preparation time	More familiar with stakeholder interests	Reduced objectivity
Expertise in a particular field	Outsider to the organisation	Increased efficiency	Insufficient time
Staff may be more honest with the external evaluator	Increased cost	Better rapport with members of the program or the organisation	
Better able to present unpopular information			
More credibility with high-level stakeholders			

Even though engaging external evaluators was a time-consuming process, the need for reliability with the results was important. Therefore, assessing the quality of student-generated learning resources and the fitness of these resources to OER was evaluated by external evaluators, and reliability was assessed after feedback by internal and external evaluators. The need for external evaluators was also important due to the diversity of the student-generated learning resource topics in the ‘Introduction to IT’ unit that required considerable knowledge in different areas.

Experience of evaluators

Selecting evaluators was a critical part for the evaluation stage in the OER development model. The selection criteria for evaluators required finding evaluators with experience in teaching the subjects of student-generated learning resources and generating digital learning resources.

The consensual assessment technique (CAT) (Amabile, 1982) provides guidance on selecting creative work evaluators. The CAT suggests that the best measure of creative work in any field is based on the combined opinions of experts in the field (Kaufman, Baer, & Cole, 2009). Therefore, it was important to have two evaluators' feedback for each group of student-generated learning resources in each subject.

Kaufman et al. (2009) conducted a study to examine novice and expert judgments of student short fiction, concluding that selecting non-expert evaluators had a high risk of invalid reliability. Thus, experience in teaching the required topics was the main criterion applied when selecting evaluators.

Domain of evaluation

Evaluating student-generated learning resources required evaluators to have considerable knowledge of the domain area of evaluation. However, other skills that could be found among participating evaluators were also critical for the evaluation stage. For example, in addition for an evaluator to possess teaching experience in the topics of student-generated learning resources, technical experience with designing online learning resources was also important. Technical experience includes the use of instructional design and learning design guidelines in creating online learning resources, and having a positive attitude and appreciation towards openness in education (i.e. OpenLearning, OER and Creative Commons licences). Therefore, the domain of evaluation, technical experience in online learning resources and positive attitudes toward openness in education are all intersected in the domain of evaluators' experience and highly preferred skills for evaluating student-generated learning resources.

Invitations and response rate

At the end of the iteration, invitations were sent to 60 nominated evaluators to assess the fitness of student-generated learning resource to OER using the developed set of evaluation criteria. The response rate was 13% from 60 higher education academics in the area of educational technology who were invited by email to participate in the evaluation process.

The invitations were also extended through 'Blended Learning Forum', a monthly forum organised by the e-Learning team at WSU. Other academics were approached by the researcher's and supervisory panel's network. The process of invitation and receiving feedback was time-consuming, however, it was an essential element that needed to be taken into account in the evaluation of student-generated learning resources.

Evaluation process

The evaluation process was straightforward, starting from sending out invitations to receiving feedback. However, due to time and resource constraints, no training was offered to the evaluators. Table 7.4 summarises the evaluation process of student-generated learning resources.

Table 7.4: Evaluation process of student-generated learning resources

Evaluation steps	Communication tools
Invite potential evaluators	Email, Skype, Forums
Received acceptance for participation	Email
Explanation of evaluation criteria	Email, Skype
Send student-generated learning resources and evaluation criteria	Dropbox
Receive feedback on evaluation results	Dropbox, Email

Phase Two presented the set of evaluation criteria as an important design principle for the OER development model that needed to be refined through Phase Three. In Phase Three, the evaluation outcome of student-generated learning resources was presented for each of the three cycles. The reliability of the evaluation criteria and consistency among evaluators were also discussed based on the evaluation outcome.

7.2.4 Diffusion of innovation

The process of adopting the OER development model in the learning environment required understanding the factors that affect the innovation adoption. Roger’s Diffusion of Innovation theory is widely used as a theoretical framework in the area of technology diffusion and adoption in different social systems. According to Rogers (2010, p. 5) ‘diffusion is the process by which an innovation is communicated through certain channels over a period of time among members of a social system’. Therefore, understanding the characteristics of different stakeholders in the OER development model helps to reflect on the design principles of the proposed model in the learning environment. The stakeholders in the OER development model are students and teachers. In-depth analysis of student characteristics was developed through the research cycles in Phase Three of all iterations.

However, the characteristics of the teaching team were highlighted in Phase One of the iterations.

In Rogers' work he identified five categories of innovation adopters based on innovativeness: (i) innovators; (ii) early adopters; (iii) early majority; (iv) late majority; and (v) laggards. In a review of Rogers' Diffusion of Innovations theory in educational technology related studies, Sahin (2006) summarised Rogers' five categories of innovation adopters as follows:

1. **Innovators** are those who are willing to experience new ideas, bring innovation from outside the organisation and prepare for challenges. Usually this group has complex technical knowledge.

2. **Early adopters** are the role models for the group members who take over leadership in the adoption of new innovations, however, they are limited to the boundaries of the social system in bringing forth new ideas.

3. The **early majority** group represents those who are neither the first nor the last to adopt an innovation, therefore, their adoption of new innovation usually takes more time than innovators and early adopters. Even though they do not take on the leadership role, they act through their interpersonal network in the innovation-diffusion process.

4. The **late majority** group is more sceptical about adopting new innovations and are usually influenced by economic necessity and peer pressure to persuade them to act.

5. **Laggards** have a traditional viewpoint and are more sceptical about innovations and change agents than the late majority group. They are limited in their leadership roles and also known for limited resources and lack of awareness of new innovations. They prefer to see successful adoption of new innovation by other members in the social system before they adopt it.

Hence, for the OER development model to achieve its aims, it is important to identify the characteristics of the teaching team. Consequently, the identified characteristics were used to reflect on the teacher's role in the final design principles of the OER development model.

Diversity among unit coordinators existed in terms of previous adoptions of ICT in the learning process and adoption of the OER development model. In the three stages of the research in this thesis, there were three different unit coordinators. Unit coordinator of Cycle 1 (Iteration 0) was highly experienced in educational technology and the utilisation of ICT in learning and teaching. Therefore, adoption of the OER development model was encouraged by this unit coordinator. Collaboration between the researcher and the unit coordinator was to improve the model's integration into the learning environment rather than accepting the new innovation.

The unit coordinator of Cycle 2 in Iteration 1 also worked on Cycle 3 in Iteration 2. He had considerable experience in ICT in general, but was reluctant to use educational technologies such as the learning management system in the learning process. Therefore, as the learning management system is an essential component of communications in the OER development model, the collaboration between the unit coordinator and the researcher was on using the available educational technologies to support the implementation of the OER development model.

The third unit coordinator of Cycle 4 and Cycle 5 in Iteration 2 had early experience in using new technologies in learning and teaching. Hence, integration of the OER development model in the learning environment required technical support for the unit coordinator and students as well.

Using Roger's Diffusion of Innovation theory, the three unit coordinators could be classified in accordance with the adoption of ICT innovation in learning and teaching, as follows:

1. Unit coordinator 1 of Cycle 1 is an early adopter who showed positive acceptance and enthusiasm for the integration of the OER development model in Cycle 1. This acceptance also reflected with bringing ideas, encouraging dissemination by students as sole author and providing additional content authoring software tools for generating learning resources. Additionally, the unit coordinator required students to communicate through discussion forums of the learning management system to facilitate technical support.

2. Unit coordinator 2 of Cycle 2 and Cycle 3 is from the early majority group who was able to observe the outcome of previous iterations. This encouraged him to integrate the OER development model in Cycle 2 and Cycle 3. The unit coordinator has solid

experience in ICT in general, however, was less interest in contributing new ideas to the model and using new technologies in the learning environment compared with unit coordinator 1. For example, this coordinator tended to simplify and restrict communication with student to email, a practice that minimised the benefits of communications through the learning management systems.

3. Unit coordinator 3 of Cycle 4 and Cycle 5 is from the late majority group who was new to the areas of educational technology and utilising new technologies that enhance the learning assessment and processes. The limitation of using new technologies was observed with a paper-based portfolio for the project-based learning approach as students were required to build a portfolio of summaries of the unit topics. Nonetheless, unit coordinator 3 had exceptional enthusiasm towards creating new opportunities for improving the curriculum design by utilising new ICT. Therefore, a lack of experience in educational technology presented a barrier for such curriculum design development.

The previous experience of the unit coordinators reflected on their acceptance and adoption of the OER development model. Rogers grouped five categories of adopters into two groups: (i) early adopters group consisting of innovators, early adopters and early majority; and (ii) late adopters group consisting of late majority and laggards (Sahin, 2006). All three unit coordinators accepted the new OER development model as early adopter. However, previous experience with using ICT in learning and teaching affected the integration of the model in the learning environment, as technical support and collaboration differed for each coordinator. Additionally, as Rogers stated that age was not a significance factor between earlier adopters and late adopters on accepting new innovation (Sahin, 2006), unit coordinators 1 and 3 were of same age group, but there was a difference between them in the technical support that each unit coordinator required.

Although the discussion of diffusion of innovation theory is outside the scope of this thesis, the theory is used to identify the characteristics of the unit coordinators in terms of adopting ICT in learning and teaching, which helped to reflect on the role of teacher in the final design principles of the OER development model.

7.3 Phase Two

Further exploration of literature in the adapting stage of the OER development model, as presented in previous section, helped to refine the design principles of the proposed OER development model in this thesis. Phase Two summarised the outcome of the literature review and extended theoretical framework to be combined with pedagogical implications of the OER development model for higher education through presenting additional design principles.

Principle Four: Pedagogical framework and essential learning activities in the OER development process

The theory of constructivism forms the pedagogical framework of the OER development model. Integrating the OER development model in the educational learning environment required curriculum development of a study unit to include constructive learning approaches such as project-base learning. It also required engaging students in constructive learning activities of knowledge generation, while teachers became engaged in the learning process as facilitator and co-creators of the learning resources.

Principle Five: Utilisation of Web 2.0 in the OER development process

The adoption of Web 2.0 tools in the learning environment provided effective means for students to build and publish the learning resources individually and collaboratively. The tools provided interactivity and a simple way of co-constructing knowledge. They also facilitated the OER development process of design, collect, reuse, package, licence and publish. Wikis are recommended as the content authoring software tool for student-generated learning resources.

Principle Six: Evaluation criteria to assess the fitness of student-generated learning resources to OER

A set of evaluation criteria is required to assess the fitness of student-generated learning resources to OER. The criteria needed to be integrated as part of the unit guidelines to guide students on generating learning resources and teachers on helping them with assessing student learning performance. The criteria assessed the quality of the learning resources from three perspectives: (i) technical; (ii) openness; and (iii) educational. Each perspective had sub-criteria that looked into details of the learning resources. The criteria included:

A. Technical

Design and presentation

1. Graphical user interface
2. Interactivity
3. Navigation

Reusability

1. Interoperability
2. Decomposability
3. Cohesiveness
4. Granularity

B. Openness

Availability

1. Open licence
2. Aliveness

Community of practice

1. Teacher’s trust
2. Learner’s trust

C. Educational

Content

1. Content accuracy
2. Exercise to support learning

Structure

1. Motivation
2. Alignment to learning objectives
3. Referencing

In addition to previous design principles from the starting stage and growing stage, the above principles were validated and refined over three cycles in the learning environment in Phase Three.

7.4 Phase Three

In the adapting stage, Phase Three consisted of the following three cycles:

1. Cycle 3: ‘Introduction to IT unit’ (300134) (same as Cycle 1 and Cycle 2)
2. Cycle 4: ‘Foundations of statistical modelling and decision making’ (300606)
3. Cycle 5: ‘Data mining and visualisation’ (200036)

As recommended in Iteration 1, students required further technical scaffolding in generating the OER development process. The learning scaffolding is offered for participants in the three units over the duration of each cycle. Scaffolding included: (i) conducting introductory workshops; (ii) developing the Learning Resources Card as a tool to help with structuring the learning resources; (iii) conducting technical workshop on using content authoring software tools; and (iv) utilising discussion forums for communication between the teaching team and students in all groups. The following list provides further details on each part of the scaffolding provided to students in the three cycles:

1. **Introductory workshop:** Preparing participants for the adapting stage of the OER development model (Iteration 2) started with introductory presentations that took place during Week 4 of the academic semester. The presentations covered the following areas:

   i) Value of OER and OEP in higher education.

   ii) Intellectual property issues and use of Creative Commons licences.

   iii) Process of OER development, including six learning activities.

   iv) Examples of student projects from the last two semesters.

   During the presentation, students reviewed previously developed projects from Cycles 1 and 2 of anonymous students, and were able to provide their own feedback on the previous works through in-class discussion. The anonymous evaluation provided students with an idea about the projects they were expected to generate and to think critically with learning resources design. Students were also introduced to the OER development process (Figure 7.3) and provided with examples on each learning activity.

Figure 7.3: OER development process – six learning activities

The OER development process included the following learning activities:

i) *Design:* Generating headings and subheadings of the learning resources and showing the learning objectives of SGLR can develop skills of taxonomies, planning and structuring (Tools: concept maps).

ii) *Collect:* Aggregating a set of references that can be used while developing the learning resources. This activity can develop skills of online information search, organising, structuring and sequencing, note-taking, comparing and evaluating information from different resources (Tools: search engines and OER repositories).

iii) *Reuse:* Using existing learning resources or adapting previously created learning resources as a component of the whole project. This activity can develop skills of re-representing information, making summaries, designing diagrams and generating new understanding (Tools: existing OER).

iv) Packaging: Adding labels and keywords that describe the learning resource. This activity can develop skills of coding (Tools: metadata).

v) Licensing: Associating the learning resource with open licences that describe how it can be reused by others. This activity hands students the authorship of generated resources (Tools: Open licences such as Creative Commons).

vi) Publishing: Disseminating student works as OER. This activity helps in developing an understanding of open publishing, sharing knowledge, ownership of learning experience and building portfolio (Tools: public domain and OER repositories).

These activities comprise the core of the OER development model when implemented in a study unit in an undergraduate learning environment. The activities are constructive as each activity supports the learning process in producing output that goes beyond the reused information (Chi, 2009). At the end of the presentation, students were given a summary of the unit timeframe which included other activities that they were required to complete.

2. **Learning resource card:** During Week 5, students were introduced to the learning resource card, which had been designed to support the OER development process. The leaning resource card is a data structure that includes a table describing a student-generated learning resource. The table helped students with generating the initial draft of the learning resources, in addition to identifying the main characteristics of these resources. Table 7.5 shows the structure of the learning resources card.

The learning resource card consists of six elements, each element supporting the related activity in the OER development process that was discussed in the introductory workshops (Figure 7.3). The table is also associated with further details on designing learning objectives, content authoring software tools and descriptions of Creative Commons licences. Students were given guidance in Week 5 on using the learning resource card. Learning resource cards were collected through the vUWS.

Table 7.5: Structure of the learning resource card

Design	**Complete each of the following:** The topic Learning objectives Software tool Type of learning resource: course, book, module, chapter, workshop, training, tutorial, storyline
Content and resources	**Complete each of the following:** List the headings and subheadings List the resources here including the small components(i.e.: Assessment, Simulation, Experiment, Report, Images, Quiz, Maps (geographical), Concept maps, Diagram, Chart, Table, Essay, Message, References)
Reusability	**Select one or more, and indicate how you will reuse other resources:** Mix with other content Reuse as-is Translate Others (please specify) Create my own content
Package	**Type in the keywords from the learning resource**
Licence	**Select one of the following Creative Commons licences of your learning resource, go to page 5 for detailed licences:** CC-BY CC-BY-NC CC-BY-SA CC-BY-NC-SA CC BY-ND CC BY-NC-ND
Publish	**Select one of the following:** Online with everyone in the world Only in UWS I don't want to publish

3. **Content authoring software tools workshop:** Similar to the recommendations of Iteration 1, student skills in developing learning resources required technical scaffolding for using content authoring software tools. Hence, the content authoring software tools workshop took place in Week 7 of the semester. The workshop covered the following topics:

   i) Content authoring software tools
   ii) Wikis and blogs with a focus on using WordPress
   iii) Tutorial and activities using WordPress

The workshop introduced students to the idea of generating small components that could be aggregated into larger learning resources by using different tools. The main focus in the workshop was on using wikis to generate the learning resources. Wikis are open architecture software used widely in collaborative learning, such as in student-generated content. These tools encourage active engagement of the student with content authoring.

Wikis enable rapid and easy content generation that can be shared openly on the internet. Content can include text, images, videos and hyperlinks, and be collaboratively created and developed by different users. While wikis enable student to collaboratively construct knowledge, accuracy of the content is not guaranteed unless a particular quality mechanism is used.

The content authoring software tools workshop provided students with practical activities on using WordPress wikis and building the initial draft of the learning resources content. Among the important activities of the workshop was giving students practical demonstration of working with peers and the teacher on the same wiki in which they could use to generate the learning resources. In addition, the workshop provided students with activities on using other tools to generate components that could be embedded into wikis, such as creating info-graphics, videos and hyperlinks.

4. **Discussion forums:** The discussion forums tool in most learning management systems provided asynchronous space for students to communicate online with each other and with the teaching team. Discussion forums were created for students at the six stages of developing the learning resources: (i) design: (ii) collection; (iii) reuse; (iv) package; (v) licence; and (vi) publish. Students posted their questions and inquiries to each discussion forum where the researcher was able to provide answers to all questions. However, participation in the discussion forums was low in three cycles. However, a considerable part of the feedback was conveyed to students by email and during class time.

The following sections present the actual implementation of the three cycles in the learning environments. In Phase Three, as in previous iterations, each cycle of Iteration 2 presented the description of the cycle, details of the participants, results from data collection and data analysis and outcomes. However, unlike previous iterations, at the end of Phase Three, an evaluation of the integration of the proposed OER development model in the three cycles was provided. This evaluation included (i) student feedback from an online survey (online survey about their learning experience in the OER development process; and (ii) feedback from interviewing the unit coordinators about their teaching experience through the proposed model. Eventually, analysis of the feedback was used in Phase Four to reflect on the final design principles.

7.4.1 Cycle 3 of Iteration 2: Description

Cycle 3 of Iteration 2 took place during the academic semester Spring 2013. The participants were students enrolled in the 'Introduction to IT' (300134) unit, as in Cycle 1 and Cycle 2. The reason for engaging the 'Introduction to IT' unit in Iteration 2 was to confirm results about capabilities of undergraduate students in generating learning resources in order to provide clear evidence of anticipated sustainability of the OER development model.

The unit coordinator remained the same as in Cycle 2. As mentioned earlier in Chapter Five, the 'Introduction to IT' unit in an online unit that has face-to-face tutorials which students attend to participate in formal learning activities. In Cycle 3, the researcher was assigned tutoring duties for three sessions of the unit.

The aims of conducting Cycle 3 were:

1. Validating the recommendations from Iteration 1 to enhance the design principles of the OER development model in introductory study units, in addition to assessing the adopting the OER development model into an introductory study unit and generating recommendations for model adoption in similar learning environments.

2. Developing the curriculum design to best fit introductory units such as the 'Introduction to IT' unit.

3. Developing further understanding of the technical skills in building learning resources that are required from the teachers to facilitate the OER development process for a group of students from different academic backgrounds.

4. Provide practical evidence of the importance of technical scaffolding for students through the OER development process.

7.4.2 Cycle 3 of Iteration 2: Participants

In Cycle 3, 188 students were enrolled in the 'Introduction to IT' unit for the academic semester Spring 2013. The tutorial sessions of the researcher included 74 students, of which 53 submitted their projects through the learning management system (Blackboard).

As in previous cycles, students came from different backgrounds as the unit was offered to all university students. Figure 7.4 shows the distribution of 74 participants among six schools at WSU.

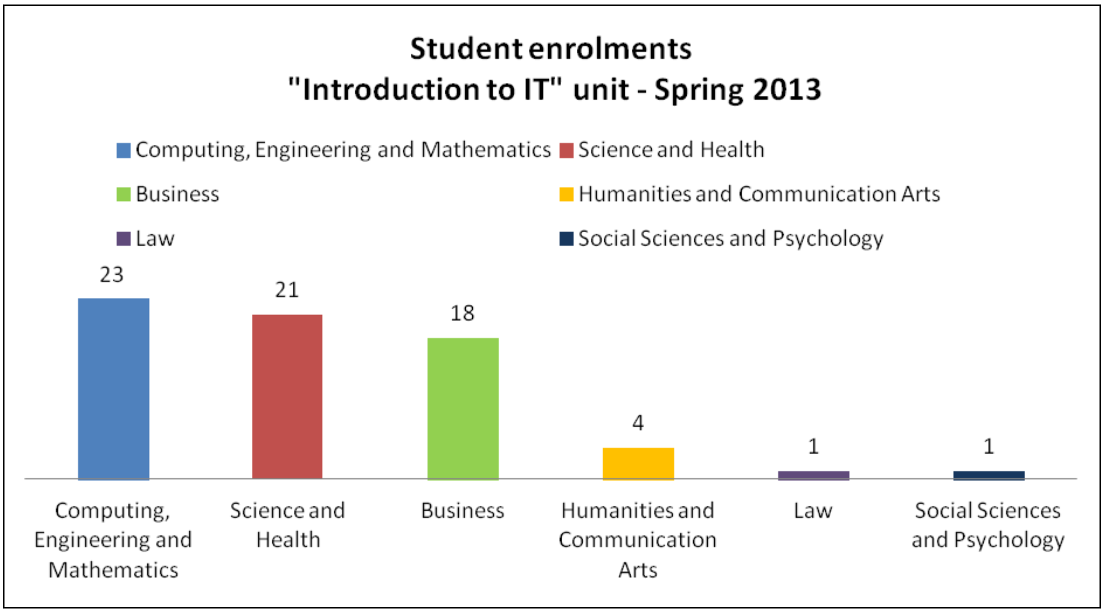


Figure 7.4: Distribution of student enrolments in the 'Introduction to IT' unit grouped by school name – Cycle 3

As in previous cycles, the majority of participating students in Cycle 3 were from SCEM, School of Science and Health, and School of Business.

7.4.3 Cycle 3 of Iteration 2: Data collection and analysis

In Cycle 3, data was collected from student assignments and student responses to an online survey. Students were given the evaluation criteria developed in Section 7.2.3 as a guide for developing their learning resources. The following subsections provide more details on student data collected.

7.4.3.1 Student projects

Fifty-three projects were submitted by students in Spring 2013 (Table 7.6). Table 7.6 lists the means and standard deviations of student projects according to their schools.

Table 7.6: Descriptive statistics of student marks grouped by school name – Cycle 3

School name	Number of projects	Mean*	Standard deviation
Computing, Engineering and Mathematics	18	9.67	2.75
Science and Health	16	10.42	2.06
Business	15	9.19	1.79
Humanities and Communication Arts	2	10.35	0.64
Law	1	10.80	-
others	1	3.00	-

*Project weight = 15 marks

The projects were assessed based on the same criteria used for Cycle 1 and Cycle 2, which evaluated the technical aspects in student-generated learning resources. Using the same evaluation criteria of Cycle 1 and Cycle 2 helped to confirm the performance of student projects from the School of Science and Health compared to other schools in producing learning resources, and their capability of effectively integrating multimedia to support the learning content as shown in Table 7.6.

In three tutorial sessions, students developed a set of learning resources in 15 areas, namely: (i) mathematics; (ii) biology; (iii) chemistry; (iv) business and marketing; (v) computing and information technology; (vi) tourism; (vii) education; (viii) arts and animation; (ix) physical education; (x) languages; (xi) engineering; (xii) health informatics; (xiii) car mechanics; (xiv) environment studies; and (xv) political studies. This diversity of topics in one academic semester collected from three sessions confirmed the evidence of cognitive surplus inside classrooms, and at the same time, showed that tapping into student-generated content can engage students in their learning experiences and provide OER for other learners to use and reuse.

Additionally, students had the choice of using one of the content authoring software tools from a list of tools in the unit learning guide published via the learning management system.

Table 7.7 shows student performance based on the content authoring tools used, as well as reports on 50 student projects, however, there were three missing that had been evaluated by another tutor of the unit.

Table 7.7: Descriptive statistics of student marks grouped by content authoring software tools – Cycle 3

Content Authoring Software Tools	Frequency of use	Percentage	Mean*	STD
Apple iBook Author	1	2%	12.9	-
Interactive Microsoft PowerPoint, Adobe PDF and Prezi	29	58%	9.89	1.84
Content based Microsoft PowerPoint, Adobe PDF files and Microsoft Word documents	9	18%	7.07	2.16
YouTube Instructional Videos and Quiz	1	2%	10.8	-
HTML format files	5	10%	10.68	2.00
Wikis and blogs	3	6%	11.45	2.51
Online magazine	1	2%	9.6	-
Online course	1	2%	13.2	-

*Project weight = 15 marks

The tendency to use Microsoft PowerPoint, Adobe PDF and Prezi remained the dominant software tools among 29 participants (58%) of Cycle 3 who scored an average of 9.89 (STD 1.84). In Cycle 3, new tools were used by students to develop learning resources as these tools provided better interactivity with the content of the resources, and mediated content generation, such as wikis and blogs. A group of 12 projects (24%) were generated using interactive content authoring software tools including Apple iBook Author, YouTube instructional videos, HTML files, Wikis and blogs, online magazine and online course, resulted in students scoring an average of 11.44 (STD=1.39) as shown in Table 7.7.

Unlike Cycle 2, the number of students who developed content based learning resources that lacked interactivity and use of multimedia to support the learning design has decreased. Therefore, it appeared from the results that scaffolding students with technical training on using content authoring software tools has a significant impact on improving the quality of learning resources.

Nonetheless, student-generated learning resources required an educational accuracy check and validation of content. This matter is the main challenge for integrating the OER development model in introductory units such as ‘Introduction to IT’. Therefore, a sample of students’ projects was sent to external evaluators in order to assess the quality of student-generated learning resources.

A sample set of 38 student-generated learning resources was evaluated by external evaluators using the evaluation criteria developed in Section 7.2.3, The response rate was very low, as explained earlier in Section 7.2.3.1, where only five evaluators were able to provide feedback for student-generated learning resources of the ‘Introduction to IT’ unit. Figure 7.5 shows the summary of the evaluation process results as received from the external evaluators by percentages.

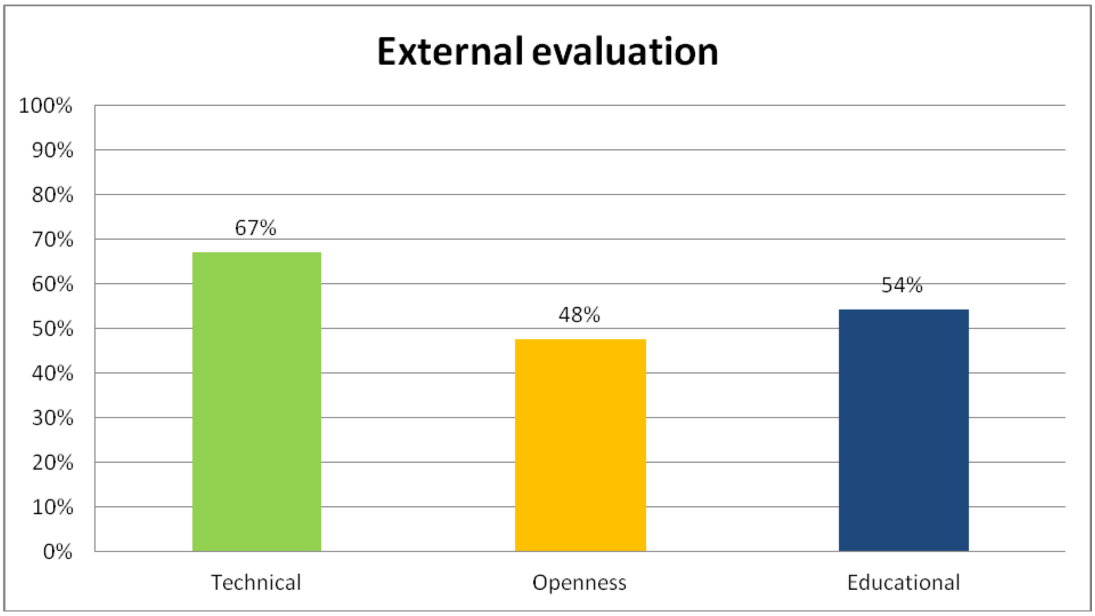


Figure 7.5: External evaluation of student-generated learning resources – Cycle 3

Evaluators reported that students were able to demonstrate good skills in terms of technical development of student-generated learning resources, however, they recommended that students require further support on improving the learning content and instructional design of learning resources. Evaluators were able to provide written feedback on the evaluation process.

Evaluator 1’s feedback on student-generated learning resources in Health and Science:

> *The resources I reviewed varied widely in the type and extent of interactivity. Most were heavily content-focused and the articulation of measurable and assessed learning outcomes was patchy at best. So I wondered whether they'd been given the same assessment rubric that we were using when they were briefed. However it is quite a demanding rubric for someone who has never tried anything like this. I wondered if the students' prior learning experiences had mostly been in the didactic teacher and/or content-centred mode. If so, they might have difficulty in addressing the criteria anyway. So I wasn't sure if I was being too harsh with some of my scoring. Maybe if the same students did a similar exercise again after feedback on their first piece of work (based on the rubric?), they might produce significantly better resources.*

Evaluator 2's feedback on student-generated learning resources in Mathematics:

> *Actually I enjoyed going through them.*

Evaluator 3's feedback on student-generated learning resources in Physical Education:

> *It is a very noble project, and hopefully it can trigger the Middle-East to start sharing more of their knowledge and wisdom to man/womankind.*

Evaluator 4's feedback on student-generated learning resources in Health and Science:

> *My vote goes to the hearing lesson made on brainshark, it was head and shoulders above the rest in my mind … Overall my summative comment would be that the students need to be exploring the new Web technologies like Nearpod, Voicethread, TEDEd, Brainshark and other tools like Captivate.*

Evaluator 5's feedback on student-generated learning resources in IT and Computing:

> *Some of the learning resources were good, solid, willing to supply them to the students after a few minor fixings. Others require a bit references and a summary list, and what ifs. However, there are some of the learning resources require examples, not clear to understand and not accurate.*

The evaluators' feedback showed that engaging students in generating learning resources was a challenging task.

On the positive side, the evaluators' feedback showed that:

1. Students were able to develop interesting projects that had potential benefits for other learners (Evaluator 2, Evaluator 3).

2. Some students demonstrated excellent learning resources that could be recommended as good references (Evaluator 4, Evaluator 5).

3. Students were able to demonstrate good utilisation of content authoring software tools as technical aspect of the learning resources was higher than openness and educational (Figure 7.5).

On the negative side, evaluators highlighted that:

1. Some learning resources were content based and required embedding more exercises and activities to improve interaction with learners (Evaluator 1).

2. Some students did not address all of the evaluation criteria in generating learning resources as some of their learning resources required further modifications (Evaluator 1, Evaluator 5, Figure 7.5).

3. Students needed to explore other content authoring tools that can improve learning resources interactivity (Evaluator 4).

The main challenge for the 'Introduction to IT' unit was the diversity of topics of student-generated learning resources, as students had to develop learning resources in topics from their academic background. This diversity of student-generated learning resources made the adjustment of educational content during the development process a cumbersome task and almost impossible to be handled by same teacher. Importantly, the teaching team members of the 'Introduction to IT' unit had academic experience in the areas of computing and IT. As a result, and in order to significantly improve student-generated learning resources, it was recommended that future students of the 'Introduction to IT' unit be engaged in developing learning resources of the unit's topics. In this case, teachers of the unit would be able to adjust the learning content accuracy and validate the resources educational value.

7.4.3.2 Online Survey 1 – Student experience in generating online content

As presented earlier in Section 5.4.3.2 and explored in Cycle 1, the cognitive surplus emphasised a need for establishing a social motivation for students to transform their cognitive surplus into items of public and civic values for others. Additionally, Cycle 2 of Section 6.4.3.2 showed that the ‘sharing knowledge’ motive could benefit students to transform online activities that have personal and communal values to activities with public and civic value. Therefore, in Cycle 3 the attempt to collect further data from students helped with distinguishing their sharing behaviour of different online activities, in addition to further understanding their experience with sharing student-generated content.

In Cycle 3, survey invitations and consent forms were sent through vUWS. The online survey was launched on Week 3 of the academic semester. The survey response rate was 59.5%, with 44 responses collected from the three sessions mentioned above in the participants section. Responses were gleaned from partially completed responses and filtered to the 18-24 age group to become 39 responses.

The survey consisted of six parts: (i) demographics; (ii) general experience with internet technology; (iii) student skills in using content authoring software tools; (iv) experience with user-generated content; (v) experience with student-generated content; and (v) student incentives toward creating and sharing content online.

1. Demographics

In Cycle 3, the research continued to be selective for the 18-24 year age group in which 39 students responded to the online survey. The sample consisted of 28 male participants (72%) and 11 female participants (28%). The majority were Australian residents (90%) and the remainder were international students (10%).

2. General experience with internet technology

Twelve (31%) students described themselves as having strong competency in using technology; of which 67% said they possess average competency in using technology. One (3%) student reported less than average competency in using technology, and no students said they have no competency. Students were asked about their Web presence in one or more of the content generation websites. Table 7.8 shows detailed responses on each type they were asked about. Student responses to this part of the survey showed that they are individually engaged with online spaces such as YouTube and blogs, rather than collaboratively developed spaces such as wikis. The result from this section confirmed that most student user-generated content can lead to personal benefits for individuals. However, this cognitive surplus can be transformed to have public and civic benefits if students can learn how to repurpose the abundance of online contributions. Importantly, raising awareness of the value of openness and open practices can create motives for students to transform part of their personal activities to more important activities that have benefits for wider groups of users. In the OER development model, students learnt how to tap into their student-generated content. This experience can also have an impact on their behaviour outside the educational environment where they started to maximise the benefits of their user-generated content.

Table 7.8: Student web presence

Web presence	Percentage/frequency	
YouTube channel	49%	19
Photos or artwork collection	23%	9
Website/page	8%	3
Weblog	15%	6
Wiki	0%	0
Others	8%	3

In terms of the number of daily hours that students spend on the internet, 77% said they spend more than four hours per day, with an average time spent online for the whole sample equalled to five hours and 41 minutes. The result is almost similar to results from the previous two cycles on this part of the survey. Even though students spend considerable time on the internet for non-educational purposes, it is mostly consumed in different online activities. Most activities were identified in previous cycles as online activities that have benefits for individuals and personal gains. Therefore, there is cognitive surplus in university student life. For these cohorts of students to add important value to the whole community they need to learn how to tap into these activities.

The last question in this part of the survey concerned student familiarity with general terms related to OER. Students showed less awareness of the terms than data collected in Cycle 2, although the ranking of the terms remained almost the same. They said that they have some awareness of ‘open educational resources’, ‘open learning’ and ‘online copyrights issues’. The terms ‘open source software’ and ‘open access journals’ followed, and they listed ‘MOOC’, ‘MIT-OCW’ and ‘Creative Commons’ as the least three terms they are familiar with.

3. Student skills in using content authoring software tools

In Cycle 2, student responses were similar to Cycle 1 and Cycle 2, as they showed better competency in using common tools over advanced tools. In Cycle 3, the same list of tools was used in addition to Web 2.0 tools added to the tools list. The results were replicated from the previous cycles where students responded on the 10 point Likert scale that they are better skilled in using common content authoring software tools as the mean of responses was 5.79 (STD 2.36) and less skilled in advanced content authoring software tools with mean 2.93 (STD 1.06). In the additional groups of Web 2.0 tools, student skill levels were low with mean 2.90 (STD 0.95). Only three respondents mentioned other tools, including Gimp (image processing) and Adobe Dreamweaver (websites development). One participant mentioned Microsoft Visio (design tool), Visual Studio (programming package) and Unity (games development). The outcome of Cycle 2 recommended providing students with technical scaffolding in using content authoring software tools. The results were replicated in Cycle 3, therefore, technical scaffolding is essential for the design principles of the OER development model, as students are required to be introduced on using one of the content authoring software tools to help them with generating learning resources.

4. User-generated content

In Cycle 1 and Cycle 2, EFA helped to identify three factors that emerged among student responses to the survey question of user-generated content activities. The same question was repeated in the survey of Cycle 3, asking students about their experience in user-generated content activities based on a larger list of different activities. Data analysis from Cycle 1 and Cycle 2 showed that students engage in online activities of personal values, however, they are less active in online activities with communal and public values. The factors should not be considered as a fixed grouping of activities, rather as an initial understanding of student contribution to user-generated content. Having cohorts of students engaged with different user-generated activities required a deeper analysis of variations of the factorised activities in Cycle 2. For example, the sharing behaviour among these activities was unrevealed from the groups of activities as students can generate content for different purposes and still not share their work.

In this part of the survey, the question of user-generated activities extended on each group of activities (public, communal and personal) to contain additional activities and detailed descriptions of each activity. The new list consisted of 33 activities, helped with identifying activities in each group that are actually public or need to be degraded into communal or even personal. For example, students were asked about frequency of ‘creating video clips without sharing one the internet’, and ‘creating video clips and sharing on the internet’. Using a Likert scale, students responded to a list of 11 public activities, 11 communal activities and 11 personal activities, where the responses ranged from 4 = Daily, 3 = Very Often, 2= Occasionally and 1 = Never. Student responses confirmed the pattern observed from Cycle 1 and Cycle 2, showing that students are active on personal activities (mean 2.57, STD 0.44) more than communal activities (mean 1.98, STD 0.48) and public activities (mean 1.40, STD 0.26). In addition to confirming the observed pattern, student responses showed further evidence of the cognitive surplus in their lives, but this cognitive surplus does not create any important value unless students learn how to tap into it.

Additionally, to further understand the sharing behaviour of the participants, students were asked to indicate how active they are on pairs of particular activities of creating a particular content and sharing it, and creating the same content but not sharing. Student responses showed evidence of cognitive surplus that had never been tapped into (Table 7.9). Table 7.9 consists of part activities that students were asked about and shows that even though students create these activities occasionally, the percentage of not sharing their work is always higher than creating content and sharing it. The pattern appears in each pair in the third column of the Table 7.9.

Table 7.9: Part of the survey question responses to pairs of online activities

User-generated content online activities	Daily	Very often	Occasionally	Never
Creating videos and sharing them on the internet (i.e. YouTube)	0%	0%	26%	85%
Creating videos but not sharing them on the internet	0%	5%	41%	64%
Creating presentations and share on the internet	0%	8%	15%	85%
Creating presentations for study/work purposes without sharing on the internet	3%	36%	54%	13%
Writing documents and share on the internet	3%	5%	26%	74%
Writing documents without sharing on the internet	10%	51%	31%	15%
Creating graphics and share on the internet	3%	5%	15%	82%
Creating graphics without sharing on the internet	3%	5%	38%	56%

In order to benefit from the cognitive surplus in student lives, there is a need to raise a culture of openness and sharing among these students through formal educational settings.

Nonetheless, making OEP embedded within learning approaches as students create knowledge and share outcome is an important learning strategy that can translate the awareness of openness in education into real practice.

Finally, the follow-up questions asked if they have created user-generated content in their free time. All participants (100%) responded to this part of the survey, including 15 student (38.5%) stating ‘Yes’ when they were asked:

> *In your own free time, have you created Digital Content that can be published on the internet? For example, have you created a presentation, YouTube clip, Facebook page, Weblog, Website ...* (Appendix F)

Students submitted 12 examples of their user-generated content. The content types included Microsoft PowerPoint presentations, Microsoft Word documents, YouTube clips, google docs, blog and Facebook pages. However, only eight students (21%) said they have published their work online, six (15.4%) said that their work can be used as learning resources and three students gave genuine links of theirs work.

5. Incentives to create and share user-generated content

Students were asked about their incentives to create and share digital content on the internet, by ranking a set of incentives, where 0 means ‘Not an incentive to me’ and 100 means ‘This is a strong incentive to me’. The completion rate of this question was 38.50% (n=15). The responses confirm the previously collected information from Cycle 2 where students ranked ‘being connected with others’, ‘sharing knowledge’ and ‘help others learn’ as the top incentives. However, unlike the previous cycle, ‘money and awards’ and ‘academic publishing’ were considered fair incentives among the list. Figure 7.6 summarises incentives rankings.

As intrinsic incentives continue to appear at the top of the list for students in creating and sharing online content, these incentives are recommended to be established for integrating the OER development model in the learning environment. The establishment of identified motives can be generated through the introductory workshop of the OER development model.

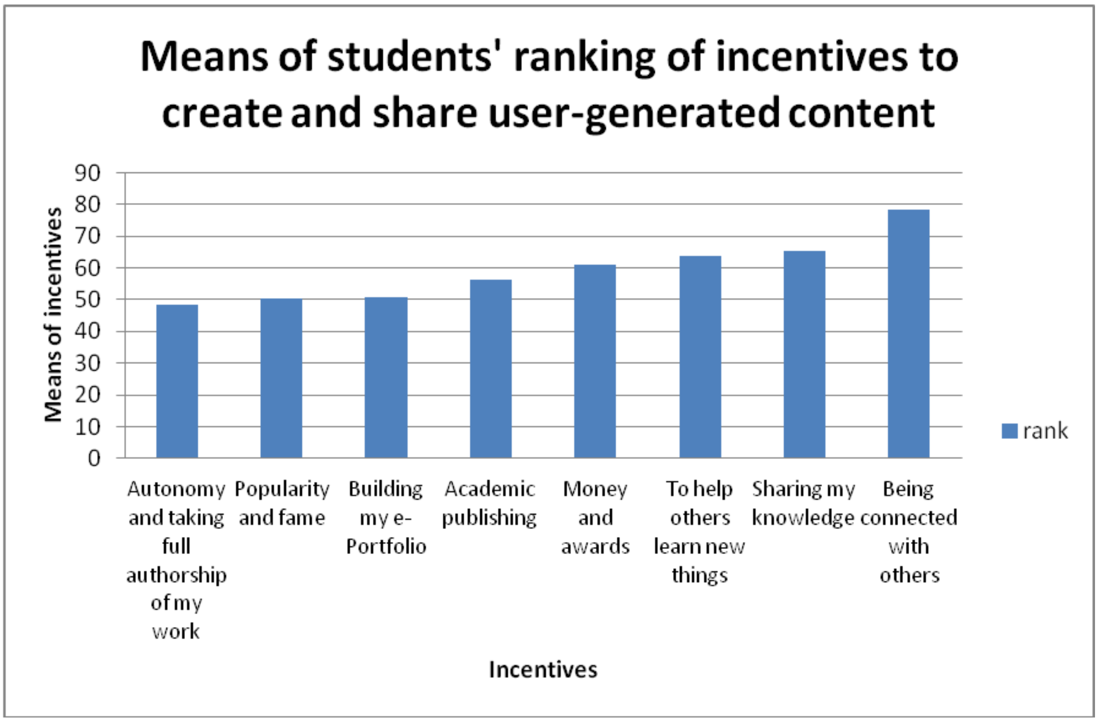


Figure 7.6: Incentives to create and share user-generated content – Cycle 3

6. Student-generated content

The final section of the survey collected data about student-generated content. Ten students (25.6%) replied positively and gave 10 examples of student-generated content. Publishing and sharing student-generated content was not considered a trend for participants in Cycle 3. Hence, the poor sharing of user-generated content observed earlier in the survey in student responses has been replicated in student-generated content. Hence, establishing incentives for students to share their student-generated content is an important design principle for the OER development model, which can transform cognitive surplus inside classrooms into resources that have important value for others.

7.4.4 Cycle 3 of Iteration 2: Outcome

Cycle 3 of Iteration 2 produced important modifications to the proposed OER development model for introductory study units. The ‘Introduction to IT’ unit was an ideal unit to show how the model works for introductory level units, as there were large numbers of students enrolled in this unit. In addition, the large number of projects that students generate on each academic semester, described in this thesis as cognitive surplus inside the classroom, has been rarely tapped into. Therefore, lessons learned from the three cycles and the outcome of model integration can be used for future reuse of the OER development model by other study units of similar learning environments. The final outcomes of Cycle 3 include the following:

1. *Academic background of students*

Student marks from School of Health and Science were higher than the rest of the sample in Cycle 3, that is, results were similar to Cycle 1 and Cycle 2. The academic background can be related to better performance in generating learning resources as students from School of Health and Sciences showed higher marks in generating learning resources. Additionally, students from School of Health and Science can be sharing particular characteristics among them, which enables them to excel in delivering better quality student-generated learning resources compared to other schools. Therefore, this conclusion has important implication for reusing the OER development model in an educational context similar to School of Health and Science. This result can be related to the topics of natural sciences studied in School of Health and Sciences, such as biological sciences and physical sciences.

2. *Establishing intrinsic motives*

Students showed that they can be motivated with intrinsic motives rather than extrinsic motives in creating and sharing knowledge. As Shirky explained the concept of cognitive surplus, adding the sharing motive to personal and communal activities can transform these activities to better activities of important benefit. Transforming student-generated content through the OER development model can be carried out by establishing the intrinsic motive of sharing what students create inside the classrooms though OER.

3. *Providing technical scaffolding for students*

Providing technical scaffolding for students has significant implications for the quality and use of interactive media with generating learning resources. Cycle 3 showed that content based student-generated learning resources have dropped to 18% compared to 30% of Cycle 2.

4. *Supporting instructional design for students*

Using the learning resources card helped students to start their projects at an earlier time of the semester, so they were able to submit an initial draft of their work. Importantly, the learning resources drafts helped students with improving the structure of student-generated learning resources by identifying learning objectives, reusing existing learning resources and other OER, and associating their work with open publishing licences such as Creative Commons.

5. *Evaluating learning resources*

Using comprehensive evaluation criteria helped with assessing student-generated learning resources from openness and educational aspects to the technical aspect. However, it was difficult for the researcher as the tutor of participating students to assess all aspects of student-generated learning resources, hence, external evaluators were invited to participate with evaluating student-generated learning resources. The outcome of the evaluation process showed that students were able to provide different levels of quality of student-generated learning resources. The feedback from external evaluators showed that even though student performance on technical aspects of student-generated learning resources was better than educational and openness aspects, they recommended further scaffolding for students in instructional design during the OER development process.

6. *Integrating the OER development model into an introductory unit*

As concluded in Section 7.4.3.1, it was highly recommended for introductory study units such as ‘Introduction to IT’ that student-generated learning resources are developed based on the unit topics.

7. *Role of the teacher*

Among the major modifications carried out in Cycle 3 was the engagement of the researcher in the teaching environment by handling tutoring duties to three sessions of the ‘Introduction to IT’ unit. The researcher worked closely with students and was able to reflect on the teaching aspect and skills that an academic is required to have to be able to support students in the OER development process. The close collaboration between the students and teacher in generating learning resources is essential to take place in synchronous and asynchronous communication modes. As a teacher’s experience in the subject area is important to adjust for content accuracy where experience in developing, digital learning resources is necessary to adjust the technical quality of student-generated learning resources. Technical quality requires teachers to have experience also in using open publishing licences such as Creative Commons licences.

7.4.5 Cycle 4 of Iteration 2: Description

Cycle 4 of Iteration 2 took place during the academic semester Spring 2013. The participants were students enrolled in the 'Foundations of Statistical Modelling and Decision Making' (300606) unit, a unit offered by the SCEM at WSU. Lectures and tutorials were usually held via access grid and the lecturer alternating between two campuses (Campbelltown and Parramatta). The unit main objective included:

> *The unit provides an introduction to the basic principles and concepts of statistics. There are two strands to the subject: distribution theory and statistical inference. The aim of the unit is to present a solid foundation in statistical theory and, at the same time, to provide an understanding of the relevance and importance of the theory in solving practical problems in the real world.*
>
> *The theoretical basis of the dual arms of classical statistical inference (estimation and hypothesis testing) is discussed relating the probabilistic half of the course to the ultimate objective – inference.* (Foundations of Statistical Modelling and Decision Making, 2013)

Students enrolled in the 'Foundations of Statistical Modelling and Decision Making' unit were invited to participate in Cycle 4 of Iteration 2 and consents were collected from all participants. The academic semester at WSU consisted of 14 weeks. Students were required to attend all classes, attempt four quizzes and submit a final project followed by a presentation of projects at the end of the semester. The project assignment was designed to assign students a number of modules from the unit and they were required to produce paper-based 'portfolios' that summarised these modules. The curriculum design of the unit was modified to accommodate the OER development model. The modification has mainly restructured the project assignment to require students to develop OER based on the unit modules using content authoring software tools.

In Cycle 4, the researcher took on the role of teaching assistant to support students with developing their projects. Similar to Cycle 3, the technical and learning scaffolding that took place in Cycle 4 included: (i) introductory workshop; (ii) learning resources card; (iii) content authoring software tools workshop; and (iv) discussion forums.

7.4.6 Cycle 4 of Iteration 2: Participants

Unlike the 'Introduction to IT' unit of Cycle 1, Cycle 2 and Cycle 3, the 'Foundations of Statistical Modelling and Decision Making' unit more advanced, therefore, offered to students at Level Two of their undergraduate study. However, the number of enrolled students was usually less than introductory units (27 students in 2011, and 18 students in 2012). In Spring 2013, eight students enrolled, however, the number dropped to four. The research has maintained the participation of this unit as it provided the opportunity of closer collaboration between the teaching team and students in developing learning resources. Additionally, the integration of the OER development model to the 'Foundations of Statistical Modelling and Decision Making' unit opened up the opportunity to tap into student-generated content (portfolios) as this area has been identified by the unit coordinator as requiring further improvement.

7.4.7 Cycle 4 of Iteration 2: Data collection and analysis

In Cycle 4, data collected from students included a learning assessment (four quizzes), the projects as student-generated learning resources and a final presentation. Conducting the assessment was part of the unit learning plan, however, this type of formative assessment provided additional resources of data that helped with assessing the learning performance of students in the learning environment that integrates the OER development model. The four quizzes conducted are explained in Table 7.10:

Table 7.10: Learning assessment – Cycle 4

Type of Assessment	Topics	Weighting	Due date
Quiz 1	Probability concepts and discrete distributions.	15%	Week 5
Quiz 2	Continuous distributions, mixed distributions, transformation of variables and distributions of sums of independent variables.	15%	Week 8
Quiz 3	Inference, point estimation, sufficient statistics and Bayesian estimation.	15%	Week 11
Quiz 4	Power and sample size, best critical regions and likelihood ratio tests.	15%	Week 12
Project	Developing learning resources based on selected modules from the unit.	20%	Week 13
Presentation	Presentation of final projects to the whole group	20%	Week 14

The unit had no final exam, however, the project assignment replaced the final exam as students needed to demonstrate their understanding of the unit topics through developing the learning resources. In addition, students were required to present learning resources to the whole group at the end of the semester. They started their projects early in the semester and received the introductory workshop in Week 4, as explained in Section 7.4. The workshop was interactive for this group of students as the group size was small (n=4).

7.4.7.1 Formative assessments

Formative assessments were conducted throughout the academic semester, which included four quizzes that took place on different times as in table 7.10. The main purpose of the formative assessment was to assess student understanding of the knowledge they have developed through generating the learning resources and their capabilities of solving theoretical problems.

Students achieved the means of marks for quizzes 1-4 (10.97, 9.02, 11.18, 13.13). As explained in Section 7.4, the process of engaging students in constructive learning activities, as in generating learning resources, supports the learning process in producing output that goes beyond the reused information. Student marks showed progress in their learning performance as marks of the associated formative assessments were improved over time. Even though such improvements can be related to student progress in knowledge development during the academic semester, previous research provided practical evidence of enhanced learning performance for students on the integration of Web 2.0 tools in the learning environment (Conole et al., 2010; Grabowski, 2009; Lee & McLoughlin, 2007; Wheeler et al., 2008). In addition, according to generative learning theory known as a second cousin of constructivism, students are more likely to understand the knowledge better if they were engaged in building it (Wittrock, 1974). Importantly, to maintain monitoring the learning progress of students in the OER development process, formative assessment can improve knowledge development and the learning gains by students.

7.4.7.2 Student projects

Similar to Cycle 3, student projects in Cycle 4 were assessed based on the evaluation criteria developed in Section 7.2.3. The evaluation criteria were used by students and the teaching team to adjust the quality of the learning resources, as students had submitted their initial draft of their project and presented it to the whole group. During the presentations, in-depth analysis and feedback of each project took place as students used the evaluation criteria during the discussion to reflect on their peers' work. At the end of the semester, all students submitted their projects and the final evaluation process included internal and external evaluators. The internal evaluation was handled by the unit coordinator of the unit and the researcher. External evaluators were approached though the researcher's professional network from outside the research, as described in Section 7.2.3.1.

Figure 7.7 shows student marks on three dimensions of the evaluation criteria as assessed by the unit coordinator. According to Table 7.10, the project weighs 20% of the final mark, however, Figure 7.7 shows the evaluation results in percentages to compare with external evaluation results.

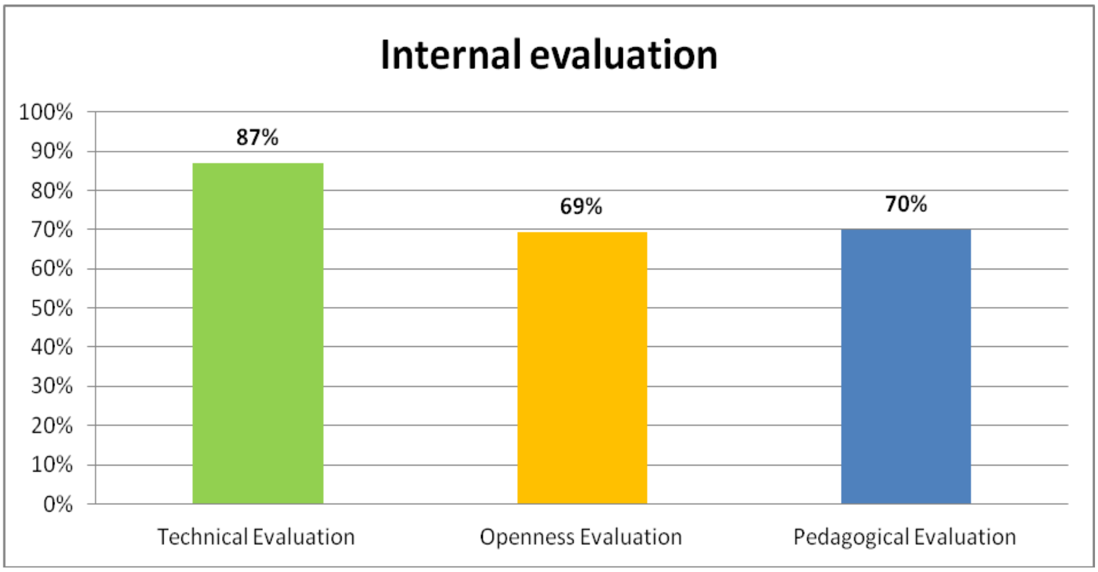


Figure 7.7: Internal evaluation of student-generated learning resources – Cycle 4

Two external evaluators were given the following evaluation feedback for the same set of student-generated learning resources (Figure 7.8).

One external evaluators of Cycle 4 provided the following feedback:

> *Actually students did a pretty good job. And next lot of students may be add on to the resources. Real test is whether other students made use of the resources and found them useful. I am pretty sure that lot of effort went towards it and they would have learned lot from this exercise.*
>
> *I learned a bit about process of creating blogs. Excel sheet was very tedious first to enter comments but I overcame this by copying and pasting from another column.*

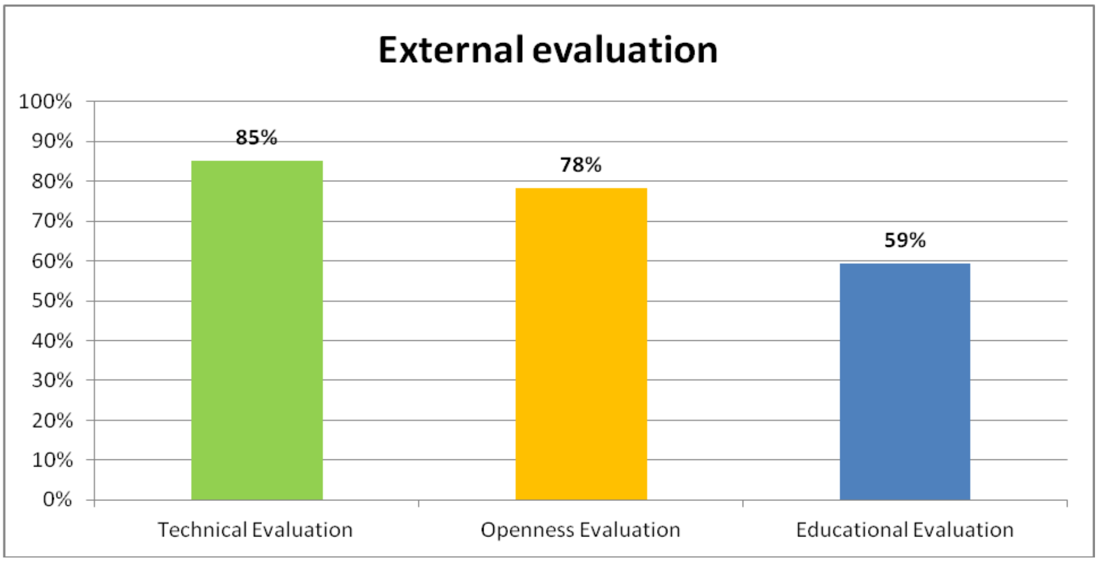


Figure 7.8: External evaluation of student-generated learning resources – Cycle 4

Internal and external evaluations reflect similar results in technical criteria, however, evaluations varies on openness and educational aspects. Therefore, to measure the actual level of agreement and consistency among evaluators, three inter-rater reliability tests were used. The first test is the traditional method of percentage of agreement, which calculates the number of agreement marks and divides by the total number of marks. The second test is the Cohen's Kappa inter-rater reliability. According to McHugh (2012), both percent of agreement and Kappa are recommended to be calculated for an inter-rater reliability test, however, both have strengths and limitations. The percent agreement is easier to calculate and results can be interpreted immediately. However, the test neglects the possibility that evaluators guessed the scores, hence, overestimating the true agreement among them. On the other hand, the Kappa considers the possibility of guessing, however, it cannot be directly interpreted.

Hallgren (2012) described two problems that can substantially cause Cohen's Kappa to misrepresent the inter-rater reliability of a test. The first is the prevalence problem where marginal distributions of observed ratings fall under one category of ratings at a much higher rate over another. This problem causes Kappa estimates to be unrepresentatively low. The second is the bias problem where marginal distributions of specific ratings are substantially different between coders, and causes Kappa estimates to be unrepresentatively high.

Therefore, as Cohen's Kappa test observes the absolute agreement between the raters and the percentage of the agreement test tends to overestimate the agreement results, the third test used was intra-class correlation which is known as one of the most commonly-used statistics for assessing inter-rater reliability for ordinal variables (Hallgren, 2012). An intra-class correlation test is selected as it assesses for consistency among the raters rather than absolute agreement between them, hence, the intra-class correlation test balances the extreme reliability results from percentage of agreement and Cohen's Kappa. Additionally, as no training was offered to evaluators on using the evaluation criteria, the measure of consistency between raters can be more accepted than absolute agreement. The rest of the current subsection provides further details about using the three tests; in addition, it presents the results from applying the reliability tests on the evaluation feedback from all evaluators.

Results of the agreement test presented in Table 7.11 show the levels of agreement between internal and external evaluators, and between external evaluators. The levels of agreement represent the difference between two evaluations on a particular criterion, for example, 'Perfect agreement' indicates that two evaluators have given the same evaluation score to the same criterion, hence, the difference between the two assigned values is 0. If the difference obtained is 1, then this indicates that the two evaluators have 'Similar agreement' although not identical. Accordingly, if there is 'Disagreement' between the two evaluators then the difference is 2 and 'Total disagreement' generates a difference of 3.

Table 7.11: Percentage of agreement between pairs of evaluators – Cycle 4

Percentage of Agreement	Evaluators		
	Internal – External	Internal – Internal	External – External
Perfect agreement	43%	55%	37%
Similar agreement	43%	28%	58%
Disagreement	8%	15%	5%
Total disagreement	5%	2%	0%

According to the percentage of the agreement test there appeared to be acceptable to good agreement among the evaluation results. The three pairs of evaluators gave identical evaluation for the internal/external pair (43%) of the learning resources, the internal/internal pair's evaluation was 55%, and external/external pair was 37% of the sample. The evaluation results also showed a small percentage of disagreement and perfect disagreement among all three pairs of evaluators. It is highly recommended to follow the percentages of the agreement reliability test with the use of a second index that accounts for agreement expected by chance (Lombard, Snyder-Duch, & Bracken, 2004; McHugh, 2012), therefore, Cohen’s Kappa was selected for measuring absolute reliability among ordinal variables.

Cohen’s Kappa (usually represented by κ (lower-case Greek letter ‘kappa’)) is a measure of inter-rater agreement between two evaluators. Kappa is always less than or equal to 1. A value of 1 implies perfect agreement and values less than 1 imply less than perfect agreement (Laerd Statistics, 2013; Lombard et al., 2004). In rare situations, Kappa can be negative, which is a sign that the two evaluators agreed less than would be expected just by chance. It is also rare to get perfect agreement as different people have different interpretations as to what is a good level of agreement. However, the inter-rater agreement test is used in content analysis as it measures the extent to which the different coders tend to assign the same rating to same object, and to find out how well the measurement system works (Tinsley & Weiss, 2000).

One possible interpretation of Kappa (Lombard et al., 2004) can be:

- Poor agreement = Less than 0.20
- Fair agreement = 0.20 to 0.40
- Moderate agreement = 0.40 to 0.60
- Good agreement = 0.60 to 0.80
- Very good agreement = 0.80 to 1.00

Unlike Cohen’s Kappa, which measure inter-rater reliability based on absolute or no agreement, the intra-class correlation test considers the degree of the disagreement to compute inter-rater reliability estimates (Hallgren, 2012). Therefore, the intra-class correlation test is selected to measure consistency among the results rather than absolute agreement.

Hallgren (2012) provided a review of four major factors that determine the selection of different ICC variants.

1. Selecting the intra-class correlation model by using a one-way or two-way model depends on the way evaluators are selected for the study. In this study, a two-way

model was selected as it was assumed that that variance of rating could be from both raters and the learning resources.

2. Specifying the type of agreement of IRR by either absolute agreement or consistency in the ratings. Absolute agreement is selected if it is important for raters to provide scores that are similar in absolute value. On the other hand, consistency is selected if it is more important for raters t provide scores that are similar in rank order. Hence, consistency was selected in this case as absolute agreement was calculated more rigorously when using the Kappa test.

3. If ratings are conducted in test and re-test style, then the average measure is selected. A single measure is selected if rating is provided only on a single test. Hence, the single measure was selected as evaluators were not offered training on using the evaluation criteria.

4. Specifying whether the coders selected for the study are considered to be random or mixed effects. This effect depends on the purpose of the study. If the purpose is meant to generalise on the larger population from where the sample is derived, the random effect is selected. On the other hand, a mixed effect model is used if no generalisation is to be made to a larger population of coders or if the coders in the study are not randomly sampled. Hence, in the evolution of student-generated learning resources the random effect was selected to generalise on the whole sample of learning resources in the study.

Higher ICC values indicate greater IRR, with an ICC estimate of 1, indicating perfect agreement and 0 indicating random agreement. Negative ICC estimates indicate systematic disagreement, and some ICCs may be less than 1 when there are three or more coders. ICC can be interpreted as follows:

- 0-0.2 indicates poor agreement
- 0.3-0.4 indicates fair agreement
- 0.5-0.6 indicates moderate agreement
- 0.7-0.8 indicates strong agreement
- >0.8 indicates almost perfect agreement.

Table 7.12 shows the result from running Cohen's Kappa and intra-class correlation in SPSS. Cohen's Kappa was performed to determine if there was absolute agreement between internal and external evaluators' judgments on the quality of student-generated learning resources developed in the 'Foundations of Statistical Modelling and Decision Making' unit. Intra-class correlation with a two-way random model was also applied on the evaluation results to determine if there was consistency among the evaluators.

Table 7.12: Cohen Kappa and intra-class correlation reliability tests between pairs of evaluators – Cycle 4

	Evaluators		
	Internal/External	**Internal/Internal**	**External/External**
Cohen Kappa	0.04	0.35	0.01
Intra-class correlation	0.13	0.47	0.36

Even though the percentage of agreement measures showed acceptable consistency among evaluations given for evaluation criteria of student-generated learning resources, Cohen's Kappa test showed significant poor agreement between internal/external evaluators and external evaluators. However, agreement between internal evaluators was fair. Additionally, the intra-class correlation showed fair agreement between the pair of internal evaluators, and fair agreement between the pair of external evaluators. Consistency between internal and external evaluators was poor.

This result produces two important indicators for using evaluation criteria and for the design principles of the OER development model. On one hand, experience with using ICT in generating OER was limited for the unit coordinator and external evaluators, who all required technical support on working with wikis and open licences. This limited experience affected their evaluation results and the use of the evaluation criteria. On the other hand, no training was offered for external evaluators prior to using the evaluation criteria, however, internal evaluators used the evaluation criteria during the semester as benchmarks to support students with generating the learning resources. Therefore, Table 7.12 shows better absolute reliability between internal evaluators compared to external evaluators.

7.4.8 Cycle 4 of Iteration 2: Outcome

Cycle 4 demonstrated that the OER development model can be integrated into a theoretical study unit, such as the 'Foundations of Statistical Modelling and Decision Making' unit. This integration revealed important outcomes for the final design principles of the OER development model, as follows:

1. **Technical scaffolding for students:** Introducing students to new content authoring software tools, such as those tools that mediate the generation of learning resources, and providing students with continuous technical support has helped with improving the final outcome of student projects. Nonetheless, encouraging students to utilise these technologies to develop their assignments and make use of the final project through sharing online has significantly transformed the curriculum design of the unit. As a result, the unit became more interactive compared to previous years. Additionally, internal and external evaluation results showed that students were able to generate quality learning resources in terms of the technical aspect.

2. **Instructional design support for students:** Using the learning resources card helped students to understand the initial idea of structuring a learning resource based on specifying its major components. As inexperienced teachers, students received a basic understanding of applying instructional design principles using the learning resources card, as the card helped them to generate well structured drafts of the learning resources.

3. **Using the evaluation criteria:** The evaluation criteria in Cycle 4 played an important role in improving the quality of student-generated learning resources. Students were able to get feedback during the lecture time from peers and the teaching team on their initial drafts based on the evaluation criteria. Using the evaluation criteria as benchmark for students and the teaching team helped with improving the learning resources, as students showed significant improvement in the learning resources at the end of the semester.

4. **Role of the teacher:** The teacher as co-creator of the learning resources gave students the opportunity to receive direct feedback on technical and educational aspects of their learning resources during the development process. Students received the teacher’s feedback through workshops, draft presentations, discussion forums of vUWS and email communications.

5. **Formative assessments:** Conducting formative assessments helped with assessing students learning performance as they worked through the semester. As the OER

development model was a new intervention to the learning environment, formative assessment maintained close monitoring for student learning progress.

7.4.9 Cycle 5 of Iteration 2: Description

Cycle 5 of Iteration 2 took place concurrently with Cycle 3 and Cycle 4 during the academic semester Spring 2013. The participants were students enrolled in the 'Data Mining and Visualisation' (200036) unit, most of whom were in their third year. The unit is offered from the SCEM at WSU. The unit delivery was the same as the 'Foundations of Statistical Modelling and Decision Making' unit of Cycle 4.

The unit's main objective included:

> *This unit presents data mining as a well structured standard process, namely, the Cross Industry Standard Process for Data Mining (CIRSP-DM) from SPSS and SEEMA from SAS. Further, this unit emphasizes (1) the presentation of data mining as a process, (2) the 'White box' approach, emphasizing an understanding of the underlying algorithmic structures, (3) the graphical approach, emphasizing exploratory data analysis, and (4) the logical presentation, flowing naturally from the CRISP-DM and SEEMA standard processes and the set of data mining tasks. This unit gives the insight of the data mining algorithms, by using small data sets and then provides examples of the application of the various algorithms on actual large data sets. Finally it provides the hands-on analysis problems, representing an opportunity to apply acquired data mining expertise to solving real problems using large data sets.* (Data Mining and Visualisation, 2013).

Cycle 4 and Cycle 5 had many similarities, for example, the same unit coordinator and the same project-based learning approach was adopted. This included the same learning scaffolding as detailed in Section 7.4. The researcher's role was a supporting role to students with similar requirements. However, unlike the theoretical nature of the 'Foundations of Statistical Modelling and Decision Making' unit, the 'Data Mining and Visualisation' unit is a practical unit that requires students to use real datasets to provide examples of the application of data mining algorithms using data mining software tools. Therefore, integrating the OER development model in the 'Data mining and Visualisation' unit was a challenging task for the participants as they were required to: (i) apply data mining algorithm; (ii) build the learning resources that explain the data mining process; and (iii) teach how to use different software tools and algorithms. Additionally, in developing learning resources, students were arranged in groups of two, with each group being assigned a specific number of modules to work on. In terms of learning assessments, during the 14 weeks of the academic semester, students were required to attend all classes, attempt two quizzes and submit a draft projects (learning resources), final projects and a presentation at the end of the semester.

7.4.10 Cycle 5 of Iteration 2: Participants

The ‘Data mining and Visualisation’ unit is an advanced unit, hence, the number of enrolments was small (n=15). All students enrolled and submitted their projects, and were from the SCEM.

7.4.11 Cycle 5 of Iteration 2: Data collection and analysis

In Cycle 5, data collected from students included student marks in assignments, draft project, a quiz, final project and presentation. The learning assessment differed from Cycle 4 because this was a practical unit where students were required to attend lectures and laboratory sessions. Assessments were conducted, as shown in Table 7.13.

Table 7.13: Learning assessment – Cycle 5

Type of Assessment	Topics Covered	Weighting	Due Dates
Assignment	Solving practical problems using the basics of SAS Enterprise Miner, Data Visualisation and Data Summarisation.	15%	Week 6
Project (draft)	Developing learning resources projects that teach the process of applying the theoretical and the applied skills learned in the unit to solve a real life problem based on given data.	20%	Week 9
Quiz	The quiz covers the following topics in predictive Modelling: Introduction to Classification and Predictive Modelling Using the Regression Node Using the Neural Network Node Using the Decision Tree Node Using the Memory Base Reasoning Node Using the Model Comparison Node	35%	Week 10
Project	Final project	20%	Week 12
Presentation	Presentation of final projects to the whole group	10%	Week 13

The projects represented student-generated learning resources that were evaluated based on the evaluation criteria designed in Section 7.2.3. The following subsections present data collected from the resources mentioned above.

7.4.11.1 Formative assessments

In Cycle 5, formative assessments were part of the unit curriculum that was used to assess student learning performance in generating the OER development model. Table 7.14 shows student performance in three assessments described in Table 7.13.

Students achieved the following mean scores in the assignment, draft presentation and quiz that were conducted during the semester.

Table 7.14: Descriptive statistics of student assessments – Cycle 5

Assessment	Percentage	Mean	Standard Deviation	Median
Assignment	15	11.19	2.06	11
Draft project	20	17.88	2.28	18
Quiz	35	23.30	2.81	23.45

The formative assessment in Cycle 5 was set differently from Cycle 4, as students were required to complete their practical assessment of solving practical problems, submitting draft project and attempting a quiz. Compared to the first two assessments, means of student marks were significantly lower in the quiz where students were examined about the knowledge they learnt during the semester. In comparing with Cycle 4 where formative assessment of four quizzes was conducted during different weeks of the semester, student learning performance was lower in Cycle 5. Therefore, in order to obtain the learning gained from the OER development model, conducting several assessments at different times during the academic semester can show improvement in student learning performance.

7.4.11.2 Student projects

As in Cycle 4, student projects in Cycle 5 were assessed based on the evaluation criteria developed in Section 7.2.3. Using the evaluation criteria, the unit coordinator assessed seven student-generated learning resources (Figure 7.9). The project weighs 20% of the final mark, however, the percentage format is used to maintain consistency with Cycle 4 and external evaluation results.

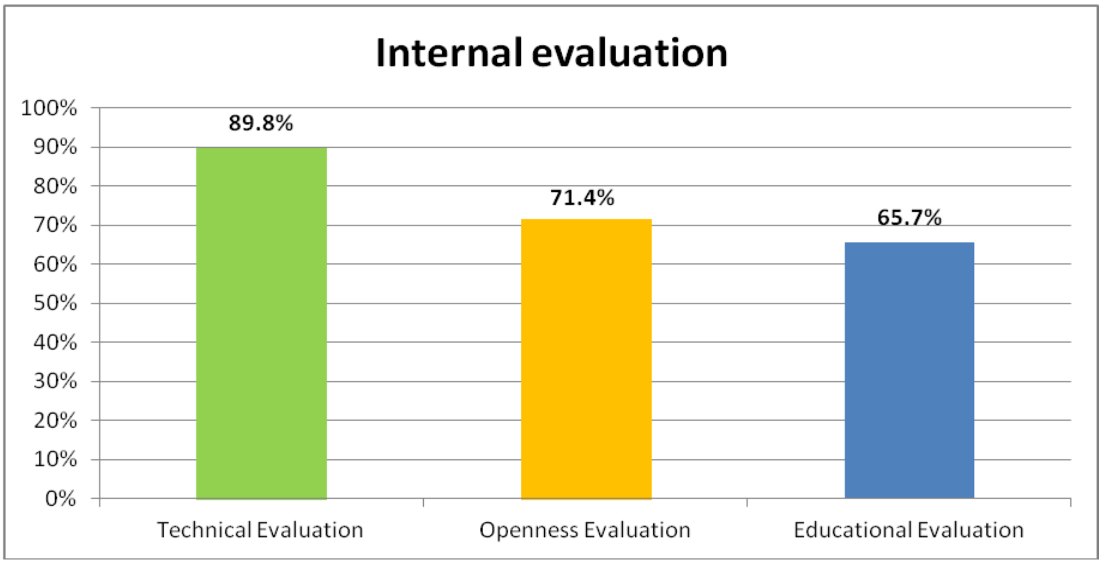


Figure 7.9: Internal evaluation of student-generated learning resources – Cycle 5

Two external evaluators were given the following evaluation for the same set of student-generated learning resources.

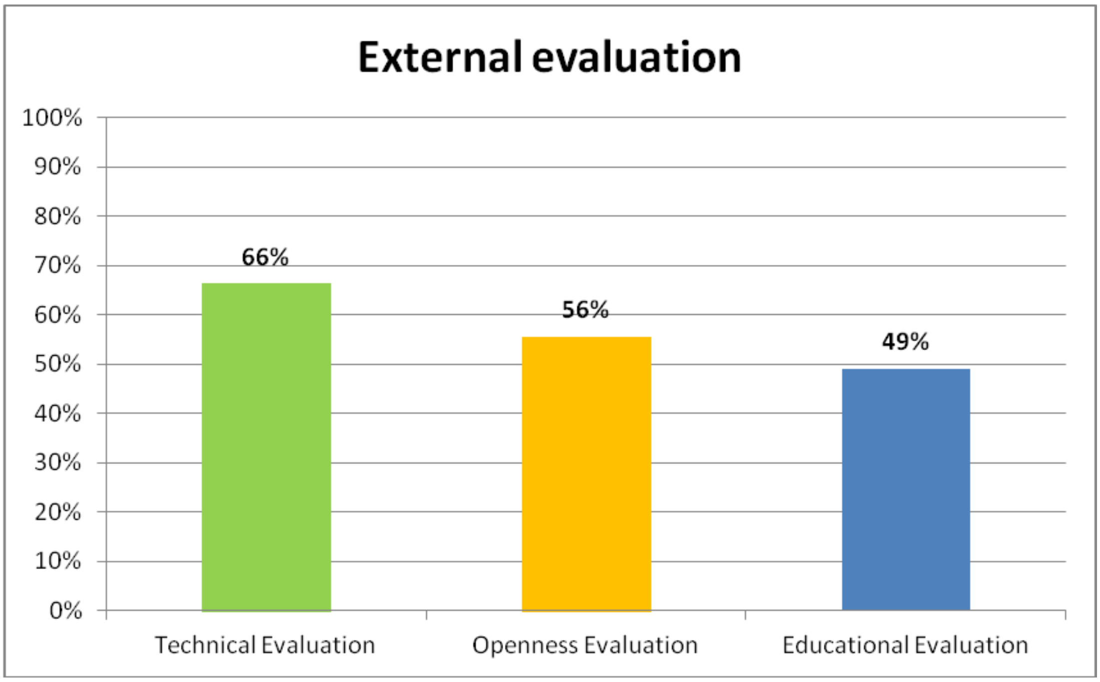


Figure 7.10: External evaluation of student-generated learning resources – Cycle 5

External evaluators have teaching experience in the area of data mining and experience in generating digital learning resources, where one has experience in OER. One external evaluator provided the following feedback:

> *They were overall interesting approaches with some variation amongst them however none stood out as exemplary over and above the rest. They all sticked to a basic formula and using the same template approach within Wordpress. Consequently I felt that the extent of the technology used to encourage interactivity was limited to video, text and some multiple choice questions. There was not much in the way of exploring a wide variety of technological approaches and creative pedagogical techniques to encourage deeper understanding of individual concepts beyond surface learning (with perhaps some student projects which used case studies). It would have been good to see more tailored exercises that emphasise the particular data mining concepts.*

The majority of evaluators in Cycle 3, Cycle 4 and Cycle 5 emphasised that the engagement of students in generating learning resources is an interesting approach that has important benefits. Some students were able to demonstrate good quality learning resources in terms of technical aspect. However, similar to some evaluators' feedback in Cycle 4, the comment from the evaluator of Cycle 5 highlighted that students required further support in utilising new technologies to embed exercises through the learning resources that encourage deeper understanding of the learning content.

In Figure 7.9 and Figure 7.10, internal/external evaluators agreed on the better technical aspect of student-generated learning resources when comparing openness with educational. Additionally, the agreement measure shows high consistency among the results (Table 7.15).

Table 7.15: Percentage of agreement between pairs of evaluators – Cycle 5

	Evaluators		
	Internal/External	**Internal/Internal**	**External/External**
Perfect agreement	41%	53%	43%
Similar agreement	46%	37%	48%
Disagreement	11%	9%	9%
Perfect disagreement	2%	1%	0%

Cohen's Kappa was performed to measure the absolute reliability between the evaluators, where intra-class correlation is used to determine if there was consistency between internal and external evaluators' judgments on the quality of student-generated learning resources developed in the 'Data mining and visualisation' unit. Table 7.16 shows the results from both tests using SPSS.

Table 7.16: Cohen Kappa and intra-class correlation reliability tests between pairs of evaluators – Cycle 5

	Evaluators		
	Internal/External	**Internal/Internal**	**External/External**
Cohen Kappa	0.14	0.24	0.23
Intra-class correlation	0.55	0.49	0.57

The test observed fair agreement between internal evaluators and fair agreement between external evaluators on the evaluation of student-generated learning resources, however, reliability was poor between internal/external evaluators. On the other hand, intra-class correlation showed fair agreement among all evaluators.

7.4.12 Cycle 5 of Iteration 2: Outcome

Cycle 5 demonstrated the integration of the OER development model in an advanced practical unit and revealed the following outcomes:

1. **Student-generated learning resources for a practical study unit:** Students were able to start using content authoring software tools at a quicker pace than students in Cycle 4, however, the use of the tools lacked the challenge for Cycle 5 students. To further challenge student skills in using content authoring software tools, generating learning resources for practical units recommended the use pf student-generated videos (Kearney et al., 2012) where students explain the use of data mining algorithms using sample data. In this case, students converted the large amount of information provided as text-based content in student-generated learning resources into interactive multimedia.

2. **Training to use evaluation criteria:** The use of evaluation criteria by evaluators showed fair agreement in most cases. Providing training for evaluators on using the evaluation criteria can help improve the agreement and reliability of the evaluation criteria.

7.4.13 Evaluation of the integration of the OER development model as a learning approach

In order to evaluate the integration of the OER development model in the learning environment, the perspectives of the students and the unit coordinators were analysed. The outcome of data analysis responds to the second research question presented in section 1.5:

Primary question 2

Does involving students in generating learning resources help improve their learning performance?

And the sub-questions

1. How does involving student in generating learning resources engage them in their learning experiences?

2. How does involving student in generating learning resources help improve their academic achievements?

3. In what way does involving student in generating learning resources help improve the educational practice?

Students were invited to complete another online survey, where unit coordinators were invited to participate in interviews. The following subsections report of both perspectives.

7.4.13.1 Online Survey 2 – Student perspectives

The survey aimed to assess student learning experience in generating learning resources and reflect on the adoption of the OER development model in the learning environment. All students who participated in Iteration 2 were invited to complete the second survey, which included 58 students from three study units. The survey was conducted in Week 12 of the semester Spring 2013. To obtain a high response rate, the survey interface was designed in three formats suitable for three different devices: (i) personal computer; (ii) tablet; and (iii) smart phone. The overall response rate was 57% (n=33) when all responses merged.

The second survey consisted of three parts: (i) demographics; (ii) student self-evaluation of their student-generated learning resources; (iii) student self-evaluation of their learning experience with generating student-generated learning resources. The following sections summarise results from each section:

1. **Demographics:** Almost three quarters of the participants (n=23) were of the age group 18-24 years, and 10 students in the age group 24-34 years as they represented students from the advanced units of Cycle 4 and Cycle 5. Unlike the first survey that took place at the beginning of Cycle 3, the purpose of the second survey was to understand the experience of the participating students after the implementation of the OER development model in undergraduate learning environments, rather than looking at students' previous experience with generating online content. Therefore, including or excluding a particular age group had no direct relation of what was anticipated from the second survey. The gender distribution remained representative of the whole sample, that is, 21 males (64%) and 12 females (36%).

2. **Self-evaluation of student-generated learning resources:** Students were asked about the quality of their learning resources, online sharing status, time required to generate the learning resource and the type of licence they used to publish their work. In terms of quality, students were asked to rank their student-generated learning resources based on technical, openness and educational criteria. The survey questions asked them about each dimension so they would generally rank their work using a Likert scale of seven stars, where 7 means 'excellent' and 1 indicates 'very bad'. The responses were normalised to percentages to be able to be compared with internal and external evaluations as in Sections 7.4.3.1, 7.4.7.2 and 7.4.11.2. Figure 7.11 summarises the result of student responses. Unlike academic evaluations of student-generated learning resources, students ranked their work as 'good' to 'very good' in the educational and the openness aspects, as well as ranked their work as 'average' to 'good' in the technical aspect.

   The results on the rest of this section are summarised in Table 7.17. Initially, in terms of sharing their work on line, students responded positively as 39% said they want to share their learning resources, and 36% indicates they have already put their student-generated learning resources online. Students who shared their learning resources were confident to do so, and have changed their behaviour of sharing knowledge, unlike the results of Survey 1 that showed poor sharing of student-generated content.

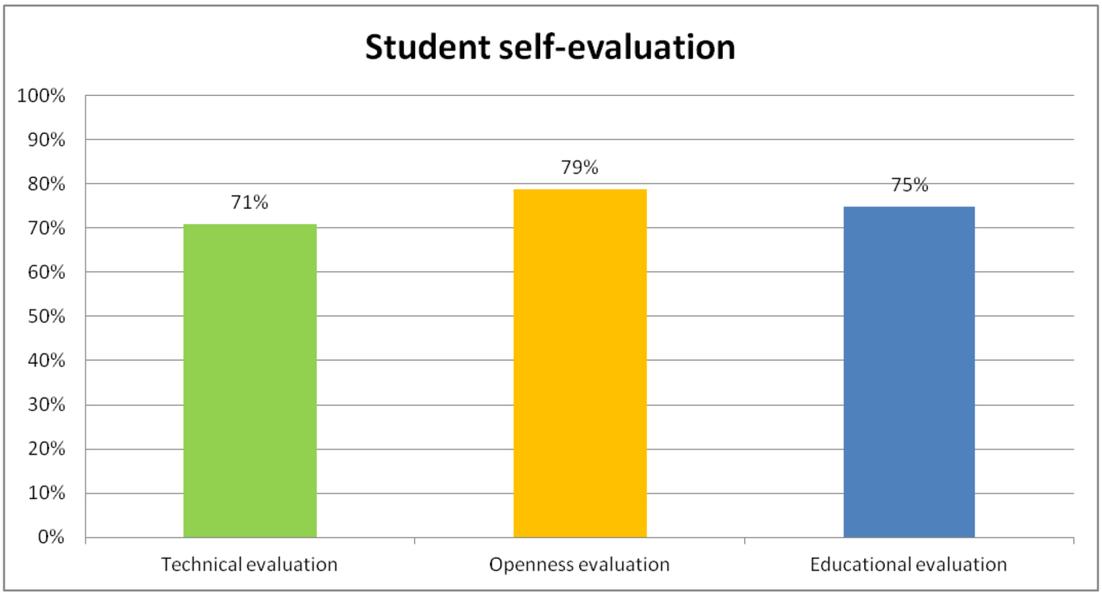


Figure 7.11: Self-evaluation results of student-generated learning resources

Hence, the integration of the OER development model in the learning environment has encouraged students to share their work, and create important value of their student-generated content by sharing their learning resources on the internet. However, almost one quarter of the students did not want to share their learning resources. This negative response can be due to the need for further modifications to be made to the learning resources. Internal and external evaluators' evaluation results showed variations of the quality of student-generated learning resources and the need for improving learning resources before publishing.

Students were also asked about the time they spent on developing their learning resources. Over 80% of students spent equal or more time on learning the content authoring software tools than time spent on developing the learning content. However, in Survey 1, almost 98% of students claimed they were competent in using new technologies. This overestimation of student technical skill competencies can be the reason behind the digital natives claims, as the results in this thesis showed that technical scaffolding for students is essential if new technologies are utilised in the learning environment.

In the last section of Survey 2, students were asked about their use of Creative Commons licences used to publish their work. Even though student responses showed that they would maintain some copyright publishing of their learning resources, their responses were biased to less restrictive licences (Table 7.17).

Table 7.17: Student responses on sharing, time spent learning software tools and using Creative Commons licences

Would you like to share your work online?	Percent	Count
Yes	39.40%	13
It’s already online	36.36%	12
No	24.24%	8
Would you say that:		
You’ve spent more time on the learning content and less time on learning the software tool you have used to build the learning resource	33.33%	11
You’ve spent less time on the learning content and more time on learning the software tool you have used to build the learning resource	12.12%	4
You’ve spend equal amount of time on both the learning content of your learning resource and the software tool you have used to build it	54.55%	18
Which Creative Commons licence you have used/you would use for your learning resource?		
Attribution	21.21%	7
Attribution-ShareAlike	30.30%	10
Attribution-NonCommercial	12.12%	4
Attribution-NonCommercial-ShareAlike	30.30%	10
Attribution-NoDerivs	06.06%	2
Attribution-NonCommercial-NoDerivs	00.00%	0

3. **Learning and technical scaffolding tools:** In order to evaluate student learning experiences in generating learning resources for OER, this part of the survey asked students to evaluate the tools used to scaffold their learning through generating learning resources. Hence, students were asked to evaluate the workshops, discussion boards, learning resources card, and overall evaluation of their learning experience in the learning environment.

   Students responded positively on the need for workshops that took place during the academic semester to support students with developing learning resources. Workshop 1 was an introductory workshop, aimed at raising awareness of OER and providing students with explanations of their roles in the research. Workshop 2 aimed at introducing students into the use of content authoring software tools to generate learning resources. Nine respondents (57.60%) of the survey who attended the workshops ranked them on a Likert scale of 10, with 10 meaning ‘extremely agree’ and 0 meaning ‘extremely disagree’. Their responses showed that the workshops were very helpful (mean 7.47), raised awareness of OER (mean 7.79) and informed on the use of Creative Commons licences (mean 7.63). Students did not agree that the workshops were not informative (mean 2.24) or not helpful (mean 1.68).

The discussion boards of vUWS were used as means of communication with the students, to support them outside their classrooms in generating learning resources. Six discussion forums were launched to discuss each step of the OER development process. Fifteen students (45%) agreed that the discussion forums were very helpful, especially in generating the learning resources. The remainder of students said they were somehow engaging (n=13) or not helpful at all (n=2). Even though the discussion forums provided students with a wider scale of discussions related to their learning process, discussion forums were not utilised by unit coordinators and had moderate traffic, as most discussions took place through email or during class time, as explained in Section 7.4.1.

With regard to using the learning resources card, students were asked about the usability and structure of the learning resources card and its significance in generating learning resources. The first part, usability and structure, was noted by 24 students (72.72%) that the learning resource card was well structured, clear and has sufficient instructions to follow. However, eight students (24%) said they required further support in using the learning resources card.

In terms of the significance of using the learning resources card, 21 students (63.3%) said that the card was an important part of the development process. However, 11 students (33.3%) said the learning resource card was not helpful in planning their learning resources projects or important for the development process. This result was expected because the card was introduced in the last iteration of the research when no further iterations took place, therefore, adjustments to the learning resource card were raised.

4. **Student perspective of incorporating the model within a study unit:** In terms of students evaluating the OER development model, 19 students (58%) said that their previous technical skills helped them with generating the learning resources, and 14

(42%) said they need further technical scaffolding. This confirms the design principle of providing technical scaffolding for students in the OER development model.

Students maintained a positive attitude on adopting the OER development model in the study unit (mean 7.5) as they responded on a Likert scale of 10 points (ranging from 10 = Extremely Agree to 0 = Extremely Disagree) that the model raised awareness of OER and the use of Creative Commons licences in their academic life. Students also agreed that the OER development model engaged them in the learning process, developed new technical skills for them and helped them with a deeper understanding of the learning resources they have developed.

The final part of this section and the survey was on self-evaluation of students' overall experience in the OER development process. Students showed high satisfaction with the idea of adopting the OER development model as a learning approach, and strongly agreed that the model helped them to share their knowledge and increase their understanding of the topic. Additionally, students agreed that the model provided them with the opportunity of ownership of their student-generated content as they said they will continue to improve their work even after the end of the semester. This satisfaction that students showed with the OER development model has encouraged unit coordinators to adopt the model as a learning strategy. Therefore, students in the three units will continue to create and share their learning resources. However, further research is required to assess the effect of student-generated learning resources on the learning outcome of other students who will use these resources.

7.4.13.2 Interviews – Unit coordinator perspectives

The unit coordinators of the participating units were invited to be interviewed. The aims of the interviews were to understand the unit coordinator's perspective of integrating the OER development model in the learning environment, and further evaluating the OER development model in real-life educational settings. Further, the interviews helped with developing feedback received from students in Survey 2 on the efficacy of the OER development model as a learning approach, and making recommendations for the future.

The first interview was with the unit coordinator of the 'Introduction to IT' unit, and the second interview was with the unit coordinator of the 'Foundations of Statistical Modelling and Decision Making' and 'Data Mining and Visualisation' units. Both interviews lasted approximately 50 minutes, and the researcher was the interviewer.

The unit coordinator of the 'Introduction to IT' unit revealed important characteristics for adopting the model as a learning approach in the learning environment.

The unit coordinator feedback was summarised into three themes:

1. **Increased student confidence with student-generated content:** Students showed more confidence with their work as some had already published their work online.

2. **Better engagement of the teaching team:** The teaching team played effective roles in the unit compared to other units, as the OER development model engaged students and teachers in the process. Feedback and communications with students were considerable during tutorials and via email.

3. **Curriculum development:** Adopting the model as part of the learning curriculum and further improvement of the learning approach of generating learning resources can be through utilising video editing tools to enhance the technical aspect of the learning resources. In addition, harnessing the use of the learning resources card provided important and initial drafts of student learning resources.

The unit coordinator of the 'Foundations of Statistical Modelling and Decision Making' and 'Data Mining and Visualisation' units highlighted similar areas and other important areas related to the learning environment that had a significant effect on student learning experience compared with previous years. The unit coordinator's feedback was summarised into four themes:

1. **Enhanced personalised learning experience:** Students in both units were able to generate their own content based on the unit topics, develop their examples, build their stories and integrate them into the learning resources. The model also harnessed the student-content relationship mainly for students in the theoretical unit, as they were more engaged with understanding the unit topics to be able to generate learning resources that can be used by others.

2. **Enhanced learning performance for low achieving students:** The model was able to support the learning process for low achieving students. Compared with previous years, students at the bottom of the list used to remain at the same level until the end of the semester, however, the model was able to support them and there was significant change. Additionally, the model helped low achieving student to progress with their learning and improve their final result. However, the model has no significant effect on students who are high achievers.

3. **Maximised learning responsibilities for students:** Prior to building the learning resources, students had to carefully understand the theoretical background of learning modules, use external resources and learn how to use content authoring software tools.

4. **Adoption of the OER development model for future semester:** The aggregation of learning resources in one place is essential so that reusability of the content can be easily accessible for future students. Additionally, modification to the learning process allows students to receive the complete learning material of a particular study unit at the beginning of the semester, and work through the semester on generating the learning content for the whole unit. Learning assessment needs to also accommodate the new approach when final examinations take place at the end of the semester.

5. **Recommendations:** Further technical support for the learning environment is required for students and teachers to accommodate new tools and improve the technical aspect of the work taking place.

Feedback from unit coordinators extends on the satisfaction that was obtained from students in Survey 2 about the integration of the OER development model as a learning approach. Even though the unit coordinators provided some modifications to the learning process through utilising further tools and adjustment to the delivery of the learning material, these modifications can be carried out without significant change to the OER development model. Additionally, the design principles of the OER development model reflect the flexibility of variation of the learning process. For example, the unit coordinator of the 'Foundations of Statistical Modelling and Decision Making' and 'Data mining and Visualisation' units showed that in future adoption of the OER development model, the learning process will be modified where students receive the complete learning martial at early the beginning of the semester and work through the semester on generating learning resources, and eventually students will be assessed in the final examination. Hence, the modification in this stage related to the learning process needs to be reflected in the recommendations of the OER development model.

7.5 Phase Four

As in previous iterations, the reflection on the design principles and proposed solution are summarised in Phase Four. The adapting stage of the OER development model in the learning environment showed how the model can be integrated into different types of learning environments. This variation includes the type of study unit (introductory, theoretical and practical), different experiences of the teaching team in using new ICT in learning and teaching, and group size.

Phase One of the adapting stage helped to generate additional design principles based on the extended literature review. The additional principles were presented in Phase Two of the same stage. The refined OER development model, including previous and additional principles, was put into practical implementation in Phase Three. Integrating the OER development model over three cycles of Phase Three generated new refinements to the additional design principles of Phase Two, including:

1. The use of evaluation criteria needs to be closely monitored by students and teachers during the OER development process in order to maintain the quality of the learning content in the development process. However, students and teachers need to be trained on using the criteria at an early stage of the development process, which can be carried out through submitting initial drafts of the learning resources at early milestones during the academic semester. Unlike student projects in Cycle 3, Cycle 4 and Cycle 5, significant improvements on student final projects after submitting initial draft (i.e.: using learning resources card or draft project) and receiving feedback based on the evaluation criteria.

2. In addition to wikis, the utilisation of other Web 2.0 tools in generating the learning resources can improve the quality of OER. Based on external evaluation feedback, other content authoring software tools can help improve the interactivity of student-generated learning resources and utilise the OER development process.

3. Phase Three also showed the impact of conducting formative assessments on monitoring student learning performance during the academic semester by comparing the outcomes of Cycle 4 and Cycle 5. Hence, an additional design principle emerged from the importance of assessing student understanding of the material of the learning resources.

4. The adapting stage (Iteration 2) helped with clarifying the role of the teaching team in the OER development model by comparing the different characteristics of unit coordinators in terms of utilising ICT in learning and teaching to support the integration of the OER development model in the learning environments.

Conducting Iteration 2 of the research helped with refinements of part of the design principles from the literature review, as well as to the generation of additional design principles as follows:

1. **Principle Five (modified) – Utilisation of Web 2.0 in the OER development process**: The teaching team needs to set up workshops for students to provide them with the required technical scaffolding on using content authoring software tools. Web 2.0 tools facilitate individual and collaborative content development, and support in using these tools is essential for students. Additionally, raising awareness of OEP by introducing students to the benefits of open licenses, and providing them with proper tools of generating these licenses through Creative Commons licenses generator.

2. **Principle Six (modified) – Evaluation criteria to assess the fitness of student-generated learning resources to OER:** In order to adjust the quality of student-generated learning resources in the development process, students and teachers need to be trained on using the evaluation criteria before starting the OER development process. Understanding each criterion is essential for them as it helps improve the quality of learning resources from three dimensions: (i) technical; (ii) openness; and (iii) educational.

3. **Principle Seven – Learning scaffolding in the OER development process:** Providing learning scaffolding for students is significant to support them in the OER development process. This includes raising awareness of the role of OER in learning and teaching, technical scaffolding on using content authoring software tools through

workshops, and learning how to design and structure learning resources using the learning resources card. The learning scaffolding needs to take place in synchronous communication, that is, in a face-to-face learning environment, as well as continuously providing students with guidance on the topics discussed in the workshops and on using the learning resources card through asynchronous communications, that is, learning management system discussion boards.

4. **Principle Eight – Learning assessments in the OER development process:** Learning assessments are essential in the OER development process and need to take place in formative assessment settings that enable the teaching team to monitor the learning progress of the students. Assessments reflect students collecting and re-representing existing OER, as well as learning as they become engaged with generating knowledge. Therefore, in order to maintain close monitoring of the performance of student learning, formative assessments need to take place throughout the academic semester. This will ensure that constructed knowledge is being understood and students are able to use and apply what they have learned through generating the learning resources.

5. **Principle Nine – The role of the teaching team in the OER development process:** Academics need to be able to utilise ICT in the learning process and accept the integration of educational technologies in the learning environment. Further, a lack of awareness of OER, OEP and technical skills in generating learning resources leads to a shortage of student support and incompleteness of the teacher's role in the OER development model. Therefore, for the OER development model to achieve its benefits the following criteria need to be met:

    i) Awareness of the benefits of openness in higher education, OER and OEP, and clarification of concerns of intellectual property issues through using open licensing.

    ii) Understanding of the online collaborative content development process using new Web 2.0 tools, and utilisation of educational technologies such as the learning management systems in the OER development process.

Hence, regardless of their technical background in using ICT in learning and teaching, raising awareness is essential for academics as the facilitators and co-creators in the OER development model to be able to support their students.

6. **Principle Ten – Integration of the OER development model into a study unit:** The integration of the OER development model into a study unit needs to be tailored to the knowledge type. This includes the development of the curriculum design required to consider the knowledge type that is offered in the unit. Therefore, for introductory, theoretical and practical units, the OER development model can be modified to match different types of unit, as follows:

    i) *Introductory units:* The OER development process should focus on generating learning resources based on unit topics, especially if students are from different academic backgrounds. In this case, collaboration between students and the teaching team will be more effective, and teachers will be able to adjust the quality of learning resources, including technical, openness and educational. In addition, for introductory units where textbooks prices can be relatively high for students to afford, developing learning resources based on the unit topics that can be used by future students have substantial potential for cutting costs for students.

    ii) *Theoretical units:* The integration of the OER development model in theoretical units provides important advantage for such types of knowledge. The OER development model is able to convert the project-based development approach from merely applying theories in order to solve textbook problems into online resources that teach others how to use these theories and how they can be used in solving problems. However, as theoretical units can be more advanced compared to introductory units in terms of the offered knowledge, it is recommended to engage students in the OER development process to develop learning resources that can be continuously improved throughout the academic years.

    iii) *Practical units:* The OER development model is best integrated in practical units when students thinking skills are optimised through engaging them in generating advanced learning resources. These learning resources need to provide case studies and exercises that support the learning process, in addition to student-generated videos, which are based on the unit topics. Hence, in order to improve student learning performance, practical units are required to challenge student capabilities through generating advanced learning resources.

7.6 Summary

Chapter Seven presented the final iteration that labels the adapting stage of the research reported in this thesis. Extending the integration of the OER development model in other units revealed more of the existing problem of cognitive surplus in higher education that needs to be repurposed in a meaningful way.

The proposed OER development model was integrated into three study units in the adapting stage and provided a practical learning approach for tapping into cognitive surplus in higher education. However, the adapting stage provided clear evidence that stakeholders of the OER development model are required to handle substantial responsibilities to increase the potential benefits of the model. On one hand, students are required to engage in all learning activities, including workshops, generate the learning resources card, use the evaluation criteria as a benchmark to adjust the quality of the learning resources and participate in the learning environment through synchronous and asynchronous means of communications. On the other hand, teachers are required to provide technical and educational scaffolding for the student. As co-creator of learning resources, teachers need to have substantial technical skills in generating learning resources and using content authoring software tools. Importantly, communities of practice of students and teachers in the OER development model need to share the authorship of the learning resources and work on publishing their work through existing OER repositories. Hence, Chapter Seven provides clear evidence that in order for the OER development model to achieve its aim, to establish communities of practice around OER in higher educational institutions, the teaching team needs to consider the technical characteristics of the students, as well as the learning environment. Importantly, the integration of the OER development model requires adjustments to the curriculum design and learning assessments in order to maintain the learning objectives of the study material and to optimise the anticipated benefits of the model.

The additional design principles generated at the end of the adapting stage were added to the final design principles of the OER development model and presented in Chapter Eight.

CHAPTER EIGHT:
DESIGN PRINCIPLES OF THE OPEN EDUCATIONAL RESOURCES DEVELOPMENT MODEL

8.1 Introduction

Chapter Eight commences with a brief summary of the thesis, followed by presenting the final design principles of the OER development model. Principles were generated and refined iteratively over three iterations of the research lifetime. Ten principles reflect the implementation of the OER development model in higher educational institutions. Recommendations for the design principles reflect on the integration and reusability of the OER development model as a running service in higher educational institutions. Chapter Eight also highlights the limitation of the research documented in this thesis, as these limitations need to be considered for the reusability of the OER development model. The research impact section emphasises three significant areas that have return on investments in open education projects, and lead to further benefits of the OER development model beyond academia. The chapter concludes with future directions that highlight important and timely development for the OER development model of this thesis.

8.2 Key findings

This section provides an overview of the key findings and a set of ten design principles that have been derived from the research reported in this thesis. These findings were used to respond to the research questions. As presented in Section 1.5, the three primary research questions were designed to investigate the research problem by focusing on three aspects including the *process*, the *outcome* and the *learning design* of the OER development model. The first and the second research question address the challenges of OER as identified in section 3.3 including raising awareness of OER in higher education, improve participation in the OER development process and quality of OER. The third research question address the proposed solution to the identified challenges. The following discussion elaborates on these findings as responses to the three research questions and subsequent questions.

Primary question 1

Does involving students in generating learning resources provide a sustainable mechanism for developing quality OER?

And its sub-questions

1. Does previous experience with content authoring software tools affect the quality of student-generated learning resources? If so, what types of content authoring software tools provide better quality student-generated learning resources?

2. Does previous experience with user-generated content affect the quality of student-generated learning resources? If so, what types of user-generated content do university students create in their daily life for non-educational purposes?

3. What are the incentives that motivate students to participate in generating learning resources for OER?

The first research question investigates the sustainability of the OER development *process* in higher educational institutions by focusing on engaging new *participants* in the OER development *process*.

As referred to in Section 1.2, sustainability of OER requires finding new participants in the OER development process. The research in this thesis provided practical examples of addressing this challenge through establishing communities of practice students and teachers in the OER development model. However, adjusting the quality of OER that are generated by students requires teachers to work closely and collaboratively with students in adjusting correctness and accuracy of the learning content.

There is clear evidence that appeared through the research iterations of the cognitive surplus inside classrooms in the large number of projects that students generate through their study years, as presented in Section 5.2.3 and Section 5.2.4. This is mainly with study units that adopt project-based learning approach in learning assessments. Over the three iterations in three consecutive academic semesters, at one introductory unit, students have collectively generated 453 projects as presented in Section 5.4.2, Section 6.4.2 and Section 7.4.2. These projects were tapped into through the research iterations by repurposing these projects towards generating OER. However, sustainability of the OER development model is not only tied to the cognitive surplus of student-generated content but also to the readiness and the capabilities of academics to provide the required technical scaffolding for their students. Results from Section 6.2.2 show that students have enthusiasm towards using new software tools, and generate learning resources; however, even though students are not equally skilled in using content authoring software tools, they are ready to participate in creating and sharing OER and willing to be guided by academics through the OER development model as a part of the learning process.

The results from analysing students behaviour in sections 5.4.3.2, 6.4.3.2 and 7.4.3.2 on generating and sharing user-generated content showed that students are engaged in activities of personal value, rather than activities of communal or public value. Students are highly active in participating in social networking websites, but they need to know how to tap into this large number of user-generated content of personal value in order for them to benefit of this surplus in meaningful ways. Hence, to encourage participation of students in the OER development process content authoring software tools need to be utilised towards that purpose by showing students how to harness these software tools towards creating and sharing OER.

Furthermore, results from sections 5.2, 6.2 and 7.4 show that students are capable of using content authoring software tools, with diversity among skill levels. However, students' previous experience with content authoring software tools doesn't have direct impact on the quality of their projects. Therefore, providing students with technical scaffolding in using content authoring software tools to generated OER is essential for students' participation in the OER development process. The results also confirm that it is a myth to assume that students are tech-savvy and are confident with using technology to generating OER.

Content authoring software tools that provide interactivity such as Wikis and interactive text books helped students with improving the quality of the learning resources, as external evaluators found better quality in student-generated Wikis comparing to content based student-generated learning resources as presented in Section 7.4.13. Importantly, the quality of student-generated learning resources was found to be related to the technical aspect as well as openness and educational aspect. Therefore, even though the content authoring software tools can help to improve interactivity and the presentation of the learning content, currency and use of open licenses, accuracy of content and the instructional design scaffolding were found to be crucially important to the quality of student-generated learning resources and hence the sustainability of the OER development model.

Finally, understanding what motivates students to participate and contribute in social networking sites and student-generated content can help improve the quality of student-generated learning resources. Interestingly students were found to be motivated by the intrinsic incentives of ‘Being connected with others’, ‘Sharing knowledge’ and ‘Help others learn’ as presented in Section 6.4.3.2 and the results were similarly concluded as in Section 7.4.3.2, as the main three incentives for students to generate and share learning content online. Therefore, students’ participation in the OER development process requires establishing similar intrinsic incentives.

Primary Question 2

Does involving students in generating learning resources help improve their learning performance?

Primary Question 2 sub-questions

1. How does involving student in generating learning resources engage them in their learning experiences?

2. How does involving student in generating learning resources help improve their academic achievements?

3. In what way does involving student in generating learning resources help improve the educational practice?

The second research question investigates the quality of the outcome of the OER development process by focusing on students’ learning performance, academic achievements and educational practice of the integration of the OER development model in higher education learning environments.

The model is found to improve the learning performance, through improving student’s learning experience, academic achievement and educational practice. The OER development model provides six learning activities that engage students in open educational practices. These activities improve engagement of students with the learning content, and with their teachers and peers through the established communities of practice around the OER development process.

In terms of engagement with the learning content, the OER development model helps with improving learning performance through improving higher order thinking skills, improve access to knowledge, and allow students on unlocking their generated content by sharing it openly. In its essence the OER development model helps students to develop higher order thinking skills that is related to knowledge generation as presented in Section 7.4.7.1, where students collect learning resources using OER repositories, reusing existing OER, and licensing student-generated learning resources using open publishing licences. Additionally, Section 5.5 shows that these practices help with raising awareness of openness in education. Openness leads to improve access to knowledge as it has been identified earlier in section 2.3.1. as a key trend that affects learning, teaching and creative inquiry in higher education. Additionally, the three iterations show that technical scaffolding in using Web 2.0 tools is essential as these tools facilitate sharing student-generated content, however students were not only developing technical skills in using these tools, but also awareness of the value of sharing student-generated learning resources through OER as presented in sections 5.4.1, 6.4.1, 7.4.1, 7.4.5 and 7.4.9

The six learning activities of the OER development model require students to understand the knowledge and theory before they can be able to build the learning resources, importantly these activities allow students to improve their learning performance through deeper exploration and developing comprehension of the topic to be able to reconstruct it as learning resources. The results in Section 7.4.13.2 show that the OER development model engages students in their learning experience that leads to significant improvement in academic achievements low achieving students comparing to high achieving students.

Finally, the model help with improving educational practices as students develop their relationships with their teachers in the OER development process. Adopting the OER development model as a learning strategy provides teachers with the opportunity to access student-generated learning resources online, and provide feedback to them on different aspects.

Primary question 3

How can the proposed OER development model be designed so that it provides continuous OER service for higher educational institutions and supports students to play an active part in their learning experience? What are the design principles?

And the sub-questions

1. What are the technical scaffoldings that are required to support students in the development process of OER?

2. What is the role of the teacher in the development process?

3. What are the learning activities that support the development process?

The third research question investigates the learning design of the OER development model. Based on the outcome of integrating and evaluating the proposed OER development model in the learning environment, the following design principles emerged. The following set of 10 design principles can be reused by higher educational institutions to establish their own OER services.

The design principles of the OER development model include:

Principle One: Six elements of OER models

Principle One is based on six elements of OER models that were summarised following review of existing OER projects referred to in the literature review. These elements are essential components of OER development and should be considered for any new OER development model and in the OER development process. The elements include:

1. Learning material: The educational content of the resources that can be of different multimedia and usually forms part of the teaching course in the proposed model.

2. ICT: Different types of ICT support the development and publishing of OER, such as content authoring software tools, learning management systems and content repositories.

3. Stakeholders: Developers and users of OER, such as students and teachers are the stakeholders.

4. Institutions: Higher educational institutions are suitable environments because they have abundance of stakeholders (Element 3).

5. Learning design: The learning design is based on structuring learning resources and organising educational content and supporting learning activities.

6. Intellectual property: Open publishing licences, such as Creative Commons maintain the intellectual property of the learning resources.

Principle Two: Understanding the feasible scope of the OER project

To ensure appropriate understanding of the scope of an OER project, stakeholders need to consider the following guidelines:

1. Starting a small OER project in one study unit to understand how it will work for one group. Each learning environment is different, and student characteristics and skills also vary. Teachers' experiences in developing learning resources can be diverse and discipline-specific. In addition, the learning environment that uses ICT as an enabler of the learning process also differs from traditional classroom settings.

2. Adopting OEP by asking students to reuse existing OER and design their own learning resources open to other learners.

3. Raising awareness for the teaming team to understand the value of integrating OER in study units, by reviewing the benefits and opportunities of OER for higher education.

4. Raising awareness of the value of OER and OEP in higher education, by giving students the opportunity to be introduced to OER and their benefits during workshops. This introduction to OER can allow students to realise the opportunities that OER can offer them, and the value that they can add to the community by generating and openly sharing learning resources.

5. Understanding student motivations to create and share learning resources by collecting data about their motives.

Principle Three: Student-generated content becomes OER

To integrate the OER model into a study unit and maintain its sustainability the unit must have a project component as a part of its assessment. Where the surplus of student-generated content that are generated on every academic semester in the form of projects, portfolios and other intellectual outcomes represent sustainable resources of intellectual property that can be repurposed in the OER development process.

In project-based learning, students work collaboratively on solving genuine problems as part of the curriculum assessment by acting autonomously on how to find resources, evaluate them and use them to present new knowledge as solutions of the problem (Solomon, 2003). This learning approach is used widely among teaching units of computer science and IT in higher educational institutions, as these units are usually practical or have a practical component. These projects usually become obsolete at the end of the academic semester because they are rarely accessed. One way to access student projects is to repurpose this cognitive surplus towards generating learning resources that can be shared via OER. Therefore, for the OER development model to be integrated into a study unit, the unit must have a project requirement.

Principle Four: Pedagogical framework and learning activities

The theory of constructivism forms the pedagogical framework of the OER development model. Integrating the OER development model into an educational learning environment requires curriculum development of a study unit to include constructive learning approaches, such as project-base learning. It also requires constructive activities of knowledge generation by students as the main learning resource developers and teachers as co-creators.

The development process of student-generated learning resources includes the following learning activities:

1. *Design:* Designing headings and subheadings of the learning resources, and showing the learning objectives of SGLR, can develop skills of taxonomies, planning and structuring. (Tools: Concept maps).

2. Collect: Collecting a set of references that can be used while developing the learning resources. This activity can develop skills of online information search, organising, structuring and sequencing, note taking, comparing and evaluating information from different resources. (Tools: search engines).

3. Reuse: Reusing existing learning resources or adapting previously created learning resources as a component of the whole project. This activity can develop skills of re-representing information, making summaries, designing diagrams and generating new understanding. (Tools: Existing OER).

4. Packaging: Adding labels and keywords that describe the learning resource. This activity can develop skills of coding. (Tools: Metadata).

5. Licensing: Associating the learning resource with open licence that describe how it can be reused by others. This activity hands over the authorship of the generated resources to students. (Tools: Open licences such as Creative Commons).

6. Publishing: Publishing students work as OER. This activity helps in understanding the value of openness in learning, sharing knowledge, ownership of learning experience and building portfolio. (Tools: Existing learning resources repositories).

Principle Five: Utilising Web 2.0 in the OER development process

The adoption of Web 2.0 tools in the learning environment provides effective means for students to build and publish learning resources individually or collaboratively. The tools provide interactivity and a simple way of co-constructing knowledge. The tools also facilitate the OER development process of designing, collecting, reusing, packaging, licensing and publishing. Wikis are recommended as the content authoring software tool for student-generated learning resources. The teaching team needs to set up workshops for students to provide them with the required technical scaffolding on using content authoring software tools. Web 2.0 tools facilitate individual and collaborative content development, therefore, support in using these tools is essential for students.

Principle Six: Evaluation criteria to assess fitness of student-generated learning resources to OER

A set of evaluation criteria is required to assess the fitness of student-generated learning resources to OER. The criteria also need to be integrated as part of the unit guideline that instructs students on how to generate learning resources and for teachers to help them with assessing student learning performance. The criteria assess the quality of learning resources from three perspectives: (i) technical; (ii) openness; and (iii) educational. Each perspective has sub-criteria that look into details of the learning resources. The criteria are summarised in this principle, as follows:

- **Technical**
  - Design and presentation
    1. Graphical user interface
    2. Interactivity
    3. Navigation
  - Reusability:
    1. Interoperability

    2. Decomposability
    3. Cohesiveness
    4. Granularity

- **Openness**
  - Availability
    1. Open licence
    2. Aliveness
  - Community of practice
    1. Teacher’s trust
    2. Learners’ trust

- **Educational**
  - Content
    1. Content accuracy
    2. Exercise to support learning
  - Structure
    1. Motivation
    2. Alignment to learning objectives
    3. Referencing

Additionally, in order to adjust the quality of student-generated learning resources in the development process, students and teachers need to be trained on using the evaluation criteria before starting the OER development process. Understanding each criterion is essential for students and teachers because it helps improve the quality of the learning resources from three dimensions, that is, technical, openness and educational.

Principle Seven: Learning scaffolding in the OER development process

Providing learning scaffolding for students is significant to support student in the OER development process. This includes raising awareness of the role of OER in learning and teaching, technical scaffolding on using content authoring software tools through workshops, and learning design on structuring the learning resources using the learning resources card. Table 8.1 provides descriptions of each type of learning scaffolding.

Table 8.1: Learning scaffolding tools of the OER development process

Learning scaffolding	Tools	Content	Objectives
Raising awareness	Introductory workshop	The value of OER and OEP in higher education. Intellectual property issues and use of Creative Commons licences. The process of OER development including six learning activities. Evaluating previously designed student-generated learning resources.	Establish incentives for students to participate in OER and raise awareness of the value and the benefits of openness in learning.
Technical scaffolding	Content authoring software tools workshop	Introduce content authoring software tools. Tutorial and activities using content authoring tools.	Encourage students on generating small components and aggregate into larger learning resources by using different tools and collaborative development of learning resource.
Learning design	Learning resources card	Six elements of learning activities each supports the related activity in the OER development process that were discussed in the introductory workshops. Instructional design principles of developing the learning objectives of learning resources. List of content authoring software tools. Descriptions of Creative Commons licences.	Students complete the learning resources card as an initial draft of the learning resources.

The learning scaffolding needs to take place in synchronous communication (face-to-face learning environment), as well as continuously provide students with guidance on the topics discussed in the workshops and use the learning resources card through asynchronous communications (learning management system discussion boards).

Principle Eight: Learning assessments in the OER development process

Learning assessments are essential in the OER development process and need to take place in formative assessment settings, which enable the teaching team to monitor the learning progress of students. Assessments are employed to reflect students who collect and re-represent existing OER and also learn as they become engaged with generating knowledge. Therefore, in order to maintain close monitoring of student learning performance, formative assessments need to take place throughout the academic semester.

This will ensure that constructed knowledge is being understood and students are able to use and apply what they have learned through generating the learning resources.

Principle Nine: Role of the teaching team in the OER development process

Academics need to be able to utilise ICT in the learning process and accept the integration of educational technologies in the learning environment. Further, lack of awareness of OER and OEP and lack of technical skills in generating learning resources lead to a shortage of students support and incompleteness of the teacher's role in the OER development model.

Therefore, for the OER development model to achieve its benefits, the following criteria need to be met:

1. Awareness of the benefits of openness in higher education, OER and OEP, as well as clarification of concerns of intellectual property issues through using open licensing.

2. Understanding the online collaborative content development process when using new ICT tools, and utilising educational technologies such as the learning management systems in the OER development process.

Hence, regardless of academics' technical background in using ICT in learning and teaching, raising awareness is essential for them as facilitators and co-creators in the OER development model to be able to support their students.

Principle Ten: Integrating the OER development model into a study unit

The integration of the OER development model into a study unit needs to be tailored-based on the knowledge type. The development of the curriculum design needs to consider the knowledge type that is offered in the unit. Therefore, for introductory, theoretical and practical units, the OER development model can be modified to match different types:

1. *Introductory units:* The OER development process should focus on generating learning resources based on unit topics, especially if students of different academic backgrounds. In this case, the collaboration between students and the teaching team will be more effective, and teachers will be able to adjust the quality of the learning resources, including technical, openness and educational qualities. In addition, for introductory units where textbooks prices can be relatively high for students to

afford, developing learning resources based on the unit topics for use by future students has potential for significantly cutting costs for students.

2. *Theoretical units:* The integration of the OER development model in theoretical units provides important advantages for such type of knowledge. The OER development model is able to convert the project-based development approach from merely applying theories that solve textbook problems to supplying online resources that teach others how to use these theories and how they can be used in solving problems. However, as theoretical units can be more advanced than introductory units in terms of the offered knowledge, it is recommended that students be engaged in the OER development process to develop learning resources that can be continuously improved throughout the academic year.

3. *Practical units:* The OER development model is best integrated in practical units where student thinking skills are optimised through engaging them in generating advanced learning resources. These learning resources need to provide case studies and exercises that support the learning process in addition to student-generated videos, which are based on the unit topics. Hence, in order to improve student learning performance, practical units are required to challenge student capabilities through generating advanced learning resources.

Even though the research in this thesis focused on the learning environment inside the classroom, the institutional role needs to be highlighted and acknowledged in the OER development model. The integration of OER development model requires institutional initiatives and policies that support the role of openness in learning and teaching. Section 8.3 presents additional recommendations for the OER development model in higher education.

8.3 Recommendations for the application of design principles of the OER development model

Among the objectives of the research reported in this thesis was to create a sustainable OER development model that can be reused by other higher educational institutions. It is important to highlight that reusability has different faces (Wiley, 2007), however, the significant goal of reusability of the OER development model is to maintain the sustainability of OER as a running service. The model was integrated into an introductory study unit that had a large number of enrolments over three cycles (Cycle 1, Cycle 2 and Cycle 3) during which the research process showed the role of the teaching team, effect of technical scaffolding for students and use of the learning management system in developing learning resources. The model was also integrated in two advanced study units with smaller numbers of students, as well as able to report on the integration of the model in a theoretical study unit (Cycle 4) and practical study unit (Cycle 5). Hence, reusing design principles of the OER development model can be tailored to fit into different learning environments.

Therefore, a set of recommendations was generated during the integration of the OER development model over three iterations. The following recommendations can be considered when reusing the design principles of the model:

1. **Integrate** the OER development model into introductory units through engaging students in generating learning resources of the unit topics, as shown in Chapter Seven. This has two benefits: (i) ability of the teacher to assess student learning performance through formative assessment; and (ii) generation of learning resources that can be reused by future students as primary references for the particular study unit.

2. **Encourage** students to build their personalised learning resources, such as using video generation software tools and embedding the content into wikis. This will give students the opportunity to explain the learning resources they are building as they act in their videos as teachers (Kearney et al., 2012). There is also great for improving learning performance for students as they learn by teaching (Grzega, 2005).

3. **Engage** students in a peer review process of student-generated learning resources as this type of engagement can help improve higher order thinking skills.

4. **Publish** student works through the university library website, allowing the library to aggregate, manage and arrange access to learning resources in one place. Implementing this recommendation has the potential to showcase the achievements of university graduates by its students.

8.4 Limitations of the study

The research process documented in this thesis has been challenged by factors that limited the study. One of the main challenges was a lack of awareness of OER in higher education, which affected a number of participating study units. Although this challenge may be related to other reasons, such as academics being busy with their daily activities, many of the invited unit coordinators requested further information about what OER represent.

The context of the study also represented another limitation to the research outcome as the OER development model was suitable for integrating into the study units at the SCEM. Nonetheless, data analysis in the ‘Introduction to IT’ unit in the three iterations provided an interesting outcome, where students with academic background from School of Health Sciences showed better performance in the quality of student-generated learning resources. Therefore, further research is recommended to optimise the benefits of the OER development process in the context of health sciences. Additionally, even though the model was integrated into undergraduate study units, the model can be reused in a postgraduate learning environment where students are expected to possess advanced skills in using content authoring software tools and generating educational content.

Another limitation that needs to be highlighted is that the OER development model was developed and evaluated at WSU. The university is located in a region that has a lower participation rate in higher education compared to other areas of Sydney where 70% of students come from Western Sydney and 40% are the first member in their family to attend university (UWS International Profile, 2012). Hence, a socioeconomic factor and lack of role model may have affected the results. Therefore, future research can help with engaging new groups of participants from other parts of Sydney and comparing the results.

Finally, as time constraints represented a general challenge for research studies, providing evidence of how other learners use and benefit from student-generated learning resources was difficult to obtain. However, the adaption of the OER development model over future semesters can provide further evidence on the benefits of the model. These benefits can be obtained through replacing the student-generated learning resources with the unit textbook and encouraging future students to reuse student-generated learning resources from previous semesters to improve the quality and enrich the content.

8.5 Research impact

The Australian Research Council defines research impact as ‘the demonstrable contribution that research makes to the economy, society, culture, national security, public policy or services, health, the environment, or quality of life, beyond contributions to academia' (Australian Research Council, 2015).

Over the next three to five years, OER is considered to make a significant impact on improving learning and teaching and is expected to be among the trends that accelerate the adoption of educational technology in higher education (Johnson et al., 2014; Parr, 2015). Over the past decade, UNESCO supported OER initiatives and projects with the vewipoint that quality education is a fundamental human right. In 2012, UNESCO organised the World Open Educational Resources Congress and brought together a group of global governments, OER experts, NGOs, and educators to share ideas about OER initiatives and discuss examples of OER policies. Among the major outcomes of the congress was the Paris OER Declaration, which is considered a historic milestone in the area of OER where calls were made on governments worldwide to openly license publicly-funded educational materials for public use (UNESCO, 2014).

The COL also supports OER initiatives, as the organisation has declared itself strongly committed to the creation, adaptation and use of OER available as online digital resources in printable format. The COL considers the OER movement to be an important element of its mission of 'learning for development', as OER have the potential to increase access to education while cutting costs and improving quality.

In addition, the OER area is receiving support from other international organisations such as OECD, which collaborates with UNESCO to support the expansion of OER in its member countries (Hylén, Damme, Mulder, & D'Antoni, 2012). Nationally, there are some endeavours that encourage the adoption of OEP in higher education, such as OpenEdOz, a project that received funding in 2014 from the Office of Learning and Teaching and aims at developing the 'National Policy Roadmap' and providing evidence-based case studies to support Australian universities in creating, adapting and incorporating MOOCs and other OER in their technology-based curriculum (Wills et al., 2014).

Therefore, as OEP have a significant role in higher education, nationally and internationally, the outcomes of this thesis can contribute to advancing these endeavours. The OER development model and set of design principles were developed over research reported in this thesis. They provided a reusable artefact for other higher educational institutions to start new OER projects and participate in supporting openness and OEP in education as the openness philosophy has a promising path on advancing learning and teaching for the near future (Johnson et al., 2013, p.7). Therefore, the return on investments in open education projects can lead to further benefits beyond academia:

1. **Quality of life for students:** Students engaged in generating OER will develop an important employability skill of online content generation. The wide proliferation of the internet and continuous development of Web services have encouraged the utilisation of these tools in contemporary businesses and marketing strategies. Consequently, this ubiquity of ICT requires more skilful human resources in using and applying these technologies in business operations, because ICT literacy is required for almost every job application. However, with the introduction of Web 2.0 tools in business and marketing, employees are required to be knowledgeable beyond ICT literacy as job advertisements put demands on online content generation skills. A report produced by the Australian Flexible Learning Framework Team on the impact of e-learning on employability skills found that e-learning approaches have a positive impact on developing transformable employability skills for students, such as generating e-portfolios and developing online content (Bowman & Kearns, 2009). For example, blogging has been found to develop learning performance, engagement with the community and build employability skills (Griffith, Simmons, Wong, & Smith, 2012). It has also been argued that adopting blogging in learning approaches provides evidence of student progress towards developing skills, knowledge and attributes of professionals practice (Terrell, Richardson, & Hamilton, 2011).

   In the OER development model, students engaged with different learning activities of designing the content, collecting content that included evaluating and verifying the material, reusing the existing material, providing labels to describe the learning resource using an intellectual property licence (Creative Commons) and publishing the work online. All these activities are essential for generating online content and such skills can open up opportunities for students during their future careers. Importantly, the OER development model increased student interactions with their teachers and peers, and allocated students and teachers in communities of practice around OER through which they provided important value for themselves and other learners.

2. **Financial economical impact:** Establishing communities of practice around OER in higher educational institutions has important economical impact for students and teachers as content developers and their institutions. By integrating the OER

development model as part of a study unit where students engage in generating learning resources of the unit topics, their final products can become open textbooks to be used by future students, therefore, replacing traditional textbooks. This practice can significantly reduce the cost of purchasing printed textbooks for students. A recent study in the United States found that replacing the traditional textbook with open textbooks saved students an average of US$128 per course (Senack, 2015). The 'Introduction to IT' (300234) unit offered at SCEM, WSU recommends that students buy 'Computers are your future' text book by Diane M. Coyle. The book costs about A$160. The 'Introduction to IT' unit is an introductory study unit, and the number of enrolments is usually high at approximately 150 students. Not all students buy the new Coyle's book, but assuming 50% of enrolled students did so would lead to a total savings of approximately A$12,000 per semester. Hence, adopting the OER development model in the 'Introduction to IT' unit, and engaging students in generating open textbooks for the unit will have a significant economical benefit for students and the educational institution. For Australian university students to reduce the cost of their textbooks can be important and timely because there is current debate about the effects of policy changes in higher education, especially after the new changes will take effect in 2016 when universities will announce the tuition fees for newly enrolled students (Department of Education, 2014).

3. **Competitive advantage for university:** Adoption of the OER development model has important implications for the reputation of universities. Publishing student-generated learning resources through an OER online platform can become a marketing tool that shows the attributes of graduates to attract enrolments, in addition to establishing an online presence for the university in the open education area that allows for significant participation in the knowledge-based economy. The capacity of universities presenting their human resources of students and teachers to form active communities of practice around knowledge development in the digital age is essential for the university's role in the knowledge-based economy.

8.6 Future directions

Chapter Eight concludes the reporting on the study conducted to develop and evaluate a new OER development model for higher educational institutions. However, future work to be carried out in the same learning environment of higher education is set to take three directions: (i) Feasibility of student-generated open textbooks; (ii) Reuse to improve student-generated learning resources as part of the learning process; and (iii) Publishing through university library website.

8.6.1 Feasibility of student-generated open textbooks

Open textbooks as one type of OER can be defined as freely available digital textbooks that are licensed under an open intellectual property licence and can be used and reused by learners, teachers and researchers. The effective adoption of open textbook in formal learning started after the introduction of Web 2.0 tools (Gehringer, 2011). Open textbooks provide practical evidence that student learning outcomes are equivalent to traditional textbooks being used (Robinson, Fischer, Wiley, & Hilton, 2014) in addition to financial benefits that have been witnessed for adopting open textbooks in educational systems (Senack, 2015; Wiley, 2012). The integration of OER development to engage students in generating open textbooks for an introductory study unit can produce promising benefits from an educational and economical returns perspective.

This initiative requires utilising content authoring software tools for individual development of the learning resources, such as eBook creators. This can create great potential for students to publish their work via online application stores, as well as lead to cost saving benefits, where students can obtain open textbooks, such as in introductory units at no cost, which eliminates having to buy expensive books. Among recommendations for generating open textbooks following the OER development model are:

1. Students can use eBook creator software tools where they can receive support from academics during the development process as students and the teacher obtain authorship rights of the learning resource, which represent the quality assurance of the learning content.

2. Students and teachers can have the chance to publish their open textbook for future students via application stores without charge.

3. Intellectual property is owned by the university, teacher and student as one group.

4. Students can lease open textbooks by paying a fee for access to each semester.

8.6.2 Reuse to improve student-generated learning resources as part of the learning process

The integration of the OER development model in a study unit results in student-generated learning resources that either can be shared directly or need further improvements. For learning resources that require further amendments, future students can reuse student-generated learning resources to improve previous work. Improving previous work and reuse to improve as a learning approach will maintain the currency of learning resources, as well as sustainability of the OER in higher educational institutions. Additionally, students can learn from their mistakes and work on improving the work that requires higher order thinking skills of evaluating previous work, analysis of weakness and improving the content.

8.6.3 Publishing through university library website

During the research cycles in this thesis, student-generated learning resources were shared through the learning management system and published in the public domain. However, the aggregation of student-generated learning resources in one repository can improve the search results from search engines and provide a shared repository for additional student-generated learning resources. Therefore, there is a need for these resources to be collected, interpreted and kept up-to-date by content curators (Bijsterveld, 2013). The university library website is the recommended place to publish these resources because the library hosts a wide range of learning resources, including student projects. Publishing through the university library website can also have competitive feature of the university as they can showcase graduate attributes and provide tangible examples of the learning outcome from the university. Therefore, there is a need to understand the role of university libraries in aggregating, managing and providing access for OER that are developed by students through the OER development model.

Openness in education has proven that knowledge flourishes when shared and becomes obsolete when locked. Universities around the world incubate the largest communities of intellects and scholars, and bridging these communities with the external world remains one of the main goals of the universities. Openness has a promising path for establishing this connection between formal education and real-life practices. Adopting OEP in the learning process will open the boundaries of classrooms for sharing the knowledge production and creating valuable opportunities for learners around the world.

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List of Appendices

APPENDIX A:
RESEARCH INVITATIONS

Invitation to students

Dear student,

A research study is currently taking place at the School of Computing, Engineering and Mathematics at the University of Western Sydney in the area of Educational Technology and would like to invite you to participate.

The research is proposing a new development model for generating online learning content for Open Educational Resources (OER), which are the digitised material offered freely and openly for educators, students and self-learners to use and re-use for teaching, learning and research.

The proposed OER development model engages students in generating the learning resources for OER and share them with others around the world.

All data collected from the research will be kept confidential and your identity will not be revealed, however, if you decided to participate your learning resource may be reused by other students for educational purposes only while your copyrights will be maintained using Creative Commons license of your own choice. Further results of the research such as efficacy of the development model will be used in academic publishing. Taking part in the study is your decision and you do not have to be in this study if you do not want. If you have any questions about your rights as a research participant, you may contact The Office of Research Services at the University of Western Sydney on humanethics@uws.edu.au.

Thank you for your consideration.

Mais Fatayer

M: +61 450 475 003 | email: m.fatayer@uws.edu.au

School of Computing, Engineering and Mathematics

University of Western Sydney

Invitation to unit coordinators

Research title: Toward a sustainable model of open educational resources development: repurposing the Cognitive Surplus of 'digital native' students

I would like to invite you to participate in a research study to build online learning resources that can be shared openly among learners around the world. The research will be conducted by one PhD student and three research supervisors at the School of Computing, Engineering and Mathematics and School of Education at the University of Western Sydney, and it will take place during next Spring academic semester 2013.

We aim at this research to define a new model to build and share learning resources openly among other students in the university using vUWS learning content repository. In the area of Educational Technology this is known as Open Educational Resources (OER). OER defined as: *Digitized educational resources that are shared in public domain or have been released under an intellectual property license that permits their free use or repurposing by students, academics and life-long learners.*

Majority of learning resources available from OER are created by academics. Knowing that academics are already busy with duties other than teaching, this gives them so little time to participate in building online learning resources. In this research we propose a new development model where students can actively be engaged in their learning experiences, by creating and sharing learning resources with other students who can use, reuse and learn from. Teachers will collaborate by evaluating and supporting proper learning design for students.
Some studies show that young students have the capabilities to use new technologies better than their predecessors. They are creating and sharing online content in different social networking websites such as YouTube, weblogs and wikis. They are spending enormous time on different internet activities, the phenomena recently known as *Cognitive Surplus*.
The Cognitive Surplus can be seen around students inside and outside classrooms, and the proposed model is trying to tap into both. Students inside classrooms create different projects using available technologies and skills. However, at the end of the unit these projects, no matter how good they can be, have never been reused or shared among other students to learn from. On the other hand, they are also engaged on their own in doing user-generated content outside educational boundaries.

We would like to invite students enrolled at the unit you are teaching/coordinating to join this research. We also need to collect data from the academics and students using two surveys for students and one face-to-face interview with the academics. If you are interested to participate in this research kindly contact one of the following:
Professor Simeon Simoff at email address: s.simoff@uws.edu.au, Prof Jonathan Tapson at email address: j.tapson@uws.edu.au, Dr Joanne Orlando at email address: j.orlando@uws.edu.au, or Mrs Mais Fatayer at email address: m.fatayer@uws.edu.au.

Kind regards,

Mais M. Fatayer, PhD candidate
M: +61 450 475 003
School of Computing, Engineering and Mathematics,
College of Health and Sciences, University of Western Sydney

APPENDIX B: INFORMATION SHEETS AND CONSENT FORMS

Participant Information Sheet (Instructor)

Human Research Ethics Committee
Office of Research Services

Participant Information Sheet (Instructor)

Project Title: *Toward a sustainable model of Open Educational Resources development: Repurposing the Cognitive Surplus of Digital Native Students*

Who is carrying out the study?

The researcher undertaking this research is Mrs Mais Fatayer from the School of Computing Engineering and Mathematics. The supervisory panel includes Prof. Simeon Simoff and Prof. Jonathan Tapson from the same school, and Dr Joanne Orlando from school of Education.

What is the study about?

The main aim of this research is to engage students in building learning content and share this content with others around the world, so that they can download, use, remix and reuse the students' learning contents openly.

What does the study involve?

The researcher will contact you twice during the semester for interviews, each for 50 minutes, once at the beginning of the semester and another time at the end of the semester. The aim of the first interview is to raise awareness of Open Educational Resources movement and present to you a new development model for Open Educational Resources. The second interview will be to collect information about the effectiveness of this model in engaging students in the learning process to produce the learning content themselves.

Will the study benefit me?

As an academic; this research will work on engaging your students effectively in the learning process and may help to achieve better learning outcomes. Your students will be working collaboratively on building learning content for your teaching unit and work themselves on evaluating the content of each other. Further, the research will propose a new quality assurance mechanism that takes less time to mark, while providing a more comprehensive feedback to students. As well as effective implementation of technology in classrooms, this research will help raising the awareness of the use of Open Educational Resources in the learning process.

Will the study involve any discomfort for me?
Risk of harm or discomfort is unlikely to happen in this research.

Will anyone else know the results? How will the results be disseminated?
All aspects of the study, including results, will be confidential and only the researchers will have access to information on participants. However, the results of the study will be disseminated through conferences and writing thesis of this research.

Can I withdraw from the study?
Participation is entirely voluntary: you are not obliged to be involved and, if you do participate, you can withdraw at any time without giving any reason and without any consequences. However, we appreciate if your commitment to the research process be to the end, which involves one academic semester.

Can I tell other people about the study?
Yes, you can tell other people about the study by providing them with the chief investigator's contact details. They can contact the chief investigator to discuss their participation in the research project and obtain an information sheet.

What if I require further information?
When you have read this information, Mais Fatayer will discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact Prof. Simeon Simoff, Dean, School of Computing, Engineering and Mathematics at s.simoff@uws.edu.au, Prof. Jonathan Tapson, Deputy Dean, School of Computing, Engineering and Mathematics at j.tapson@uws.edu.au or Dr Joanne Orlando, Senior lecturer, School of Education at j.orlando@uws.edu.au or the researcher Mrs Mais Fatayer PhD candidate at m.fatayer@uws.edu.au .

What if I have a complaint?

This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is H9511

If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013 or email humanethics@uws.edu.au.
Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

If you agree to participate in this study, you may be asked to sign the Participant Consent Form.

Participant Consent Form (Instructor)

Human Research Ethics Committee

Office of Research Services

University of Western Sydney

Participant Consent Form (Instructor)

Project Title: *Toward a sustainable model of Open Educational Resources development: Repurposing the Cognitive Surplus of Digital Native Students*

I,…………………………, consent to participate in the research project titled "*Toward a sustainable model of Open Educational Resources development: Repurposing the Cognitive Surplus of Digital Native Students*"

I acknowledge that:

- I have read the participant information sheet and have been given the opportunity to discuss the information and my involvement in the project with the researcher/s.
- The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.
- I consent to provide data about my students' engagement and learning outcomes, in using technology tools to create online content, during two interviews. I understand that the interviews will be voice recorded and transcribed for analysis, and I can get a copy of interview transcript.
- I understand that my involvement is confidential and that the information gained during the study may be published but no information about me will be used in any way that reveals my identity.
- I understand that I can withdraw from the study at any time, without affecting my relationship with the researcher/s now or in the future.

Signed:
Name:
Date:
Return Address:

This study has been approved by the University of Western Sydney Human Research Ethics Committee.
The Approval ner is H9511.
If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013

or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

Participant Information Sheet (Student)

Human Research Ethics Committee
Office of Research Services

University of Western Sydney

Participant Information Sheet (Student)

Project Title: *Toward a sustainable model of Open Educational Resources development: Repurposing the Cognitive Surplus of University Students*

Who is carrying out the study?

The researcher undertaking this research is Mrs Mais Fatayer from the School of Computing Engineering and Mathematics. Supervisory panel includes Prof. Simeon Simoff, Prof. Jonathan Tapson from the School of Computing Engineering and Mathematics, and Dr Joanne Orlando from School of Education.

What is the study about?

The main aim of this research is to engage students in building learning resources and share with others around the world, so that they can download, use and reuse the learning resources openly.

What does the study involve?

The researcher will contact you during the semester by email, where you will be asked to complete online questionnaire that will take 20 minutes. The aims of the questionnaire are first to understand your experience with using technology authoring tools to build online digital content, for example creating YouTube video, Presentations, Blogs, Websites, etc, and to understand the motive behind generating and sharing these resources on the Internet.

Will the study benefit me?

Your participation in the study will support sustaining Open Educational Resources movement so people around the world regardless of where they are can benefit from the freely available learning resource you will create. Further, this can help you in building your e-portfolio. Intellectual property of resource created will be maintained under the Creative Commons license. For further details about the license visit: www.creativecommons.org.au

Will the study involve any discomfort for me?

Risk of harm or discomfort is unlikely to happen in this research.

Will anyone else know the results? How will the results be disseminated?

All aspects of the study, including results, will be confidential and only the researchers will have access to information on participants. However, the results of the study will be disseminated through conferences and writing thesis of this research.

Can I withdraw from the study?

Participation is entirely voluntary: you are not obliged to be involved and, if you do participate, you can withdraw at any time without giving any reason and without any consequences.

Can I tell other people about the study?

Yes, you can tell other people about the study by providing them with the chief investigator's contact details. They can contact the chief investigator to discuss their participation in the research project and obtain an information sheet.

What if I require further information?

When you have read this information, Mais Fatayer will discuss it with you further and answer any questions you may have. If you would like to know more at any stage, please feel free to contact Prof. Simeon Simoff, Dean, School of Computing, Engineering and Mathematics at s.simoff@uws.edu.au, Prof. Jonathan Tapson, Deputy Dean, School of Computing, Engineering and Mathematics at j.tapson@uws.edu.au or Dr Joanne Orlando, Senior lecturer, School of Education at j.orlando@uws.edu.au or the researcher Mrs Mais Fatayer PhD candidate at m.fatayer@uws.edu.au .

What if I have a complaint?

This study has been approved by the University of Western Sydney Human Research Ethics Committee. The Approval number is H9511.

If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013 or email humanethics@uws.edu.au.

Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

If you agree to participate in this study, you may be asked to sign the Participant Consent Form.

Participant Consent Form (Student)

Human Research Ethics Committee
Office of Research Services

University of Western Sydney

Participant Consent Form (Student)

Project Title: *Toward a sustainable model of Open Educational Resources development: Repurposing the Cognitive Surplus of Digital Native Students*

I,…………………………, consent to participate in the research project titled "*Toward a sustainable model of Open Educational Resources development: Repurposing the Cognitive Surplus of Digital Native Students"*

I acknowledge that:

- I have read the participant information sheet and have been given the opportunity to discuss the information and my involvement in the project with the researcher/s.
- The procedures required for the project and the time involved have been explained to me, and any questions I have about the project have been answered to my satisfaction.
- I consent to provide data about my activities, inside and outside classroom, in using technology tools to create online resources, including two surveys.
- I understand that my involvement is confidential and that the information gained during the study may be published but no information about me will be used in any way that reveals my identity.
- I understand that I can withdraw from the study at any time, without affecting my relationship with the researcher/s now or in the future.

Signed:
Name:
Date:
Return Address:

This study has been approved by the University of Western Sydney Human Research Ethics Committee.
The Approval number is H9511

If you have any complaints or reservations about the ethical conduct of this research, you may contact the Ethics Committee through the Office of Research Services on Tel +61 2 4736 0229 Fax +61 2 4736 0013
or email humanethics@uws.edu.au. Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

APPENDIX C:
HUMAN ETHICS APPROVAL

UWS HUMAN RESEARCH ETHICS COMMITTEE

29 October 2012

Professor Simeon Simoff,

School of Computing, Engineering and Mathematics

Dear Simeon,

I wish to formally advise you that the Human Research Ethics Committee has approved your research proposal **H9511** *"Toward a sustainable model of open educational resources development: Repurposing the cognitive surplus of "digital native" students",* until 1 February 2014 with the provision of a progress report annually and a final report on completion.

Please quote the project number and title as indicated above on all correspondence related to this project.

This protocol covers the following researchers:

Simeon Simoff, Graeme Salter, Mais Fatayer.

Yours sincerely

Professor Christopher Davis

Deputy Chair, UWS Human Research Ethics Committee

s.simoff@uws.edu.au

17143569@student.uws.edu.au

APPENDIX D:
ONLINE SURVEY – CYCLE 1 OF ITERATION 0

Students' Online Digital Content

Background

1) Please enter the following information:*

Your name:

Your student ID:

2) Please enter your age group*

- under 18
- 18-24
- 25-34
- 35-54
- 55+

3) What is your gender?

- Male
- Female

4) How would you describe your competency in using technology?*

- Strong competency
- Average competency
- Less than average
- Not competent

5) Do you have your own*

	Answer		Link (optional)
	Yes*	No*	
Website/page	( )	( )	
Web Blog	( )	( )	
Wiki	( )	( )	
Photos or artwork collection	( )	( )	
YouTube channel	( )	( )	
Others	( )	( )	

6) How many hours on average do you spend using the Internet?*

- Less than one hour a day
- 2-4 hours a day
- 4-8 hours a day
- More than 8 hours a day

7) Are you an Australian resident?

- Yes
- No

---

8) If you are not an Australian resident, please indicate in what country is your permanent resident?

[Drop down list of all countries in the world]

Information and Communication Technologies

9) Drag the terms that you are familiar with to the box on the right side.
Click and hold to drag terms from the left menu, and place in the box to the right.

- [ ] Creative Commons
- [ ] Open Learning
- [ ] Open Educational Resources
- [ ] MIT-OCW
- [ ] Open Source Software
- [ ] Online copyrights issues
- [ ] Open Access Journals
- [ ] MOOC (Massive Open Online Course)

10) This part asks you about your experience with using information and communication technology tools for non-educational purposes.
Please indicate: How often you have used technology in each category over the past year.
If you have never used a particular technology category, select Never.

	Daily	**Very often**	**Occasionally**	**Never**
Participating in online forums	○	○	○	○
Creating YouTube clips	○	○	○	○
Creating websites	○	○	○	○
Using Twitter	○	○	○	○
Using social networking websites (e.g: Facebook)	○	○	○	○
Blogging	○	○	○	○
Creating and managing ePortfolio	○	○	○	○
Creating Wikis	○	○	○	○
Rating products online	○	○	○	○
Uploading mobile photos	○	○	○	○
Creating Presentations	○	○	○	○
Creating and managing Databases	○	○	○	○
Adding product review comments	○	○	○	○

	Daily	Very often	Occasionally	Never
Writing documents	○	○	○	○
Sending SMS	○	○	○	○
Creating graphics	○	○	○	○
Uploading digital camera photos	○	○	○	○
Composing music	○	○	○	○
Developing iPhone/iPad applications	○	○	○	○

11) Do you have other types of online activities that you are involved in for non-educational purposes?

Authoring tools

12) The following table contains a list of tools which could be used in generating digital online content. Please indicate your skill level with each tool:

Please leave the tools that you are unfamiliar without rating
Click on the stars to select your ratings.

	Your skill level
Adobe Photoshop	
Audacity	
Flash	
Microsoft FrontPage	
Microsoft PowerPoint	
Microsoft Publisher	
Microsoft Word	
Paint.NET	
Programming languages	
Windows Movie Maker	
iBook Author	
iMovie	
Databases	
Others	

13) If there are other tools that you are skilled at, please tell us about these tools. We also would like to know how skilled you are in using these tools.

Experience with Digital Content production

14) In your own free time, have you created Digital Content that can be published on the internet?

- Yes
- No

15) We are interested in your work, please tell us more about your Digital Content

What is the title of your Digital Content?*:

What is the type of this Digital Content?*

- Presentation
- Website
- Blog
- Facebook Page
- Wiki
- YouTube
- Song
- Photos
- PDF Document
- MS Word Document
- iPhone/iPad Application
- Others

If your work is available online, please provide the web link.:

Can this Digital Content be used as Learning Content? (i.e: to help others learn something)

- Yes
- No

Question 15 is repeated three times

Do you have more Digital Content you would like to add?*

- Yes
- No

18) We would like to know more about the Digital Content you have created. Please add title and link, if available, to each content into one line.

Digital Content for educational purposes

19) Have you created Digital Content before in any of your study units for educational purposes, for example projects, assignments, presentations, documents or any kind of Digital Content?*

- Yes
- No

20) If you answered Yes on previous question, please complete the following questions related to your Digital Content.

What is the name of the study unit for which you have created the Digital Content?:

What is the title of your Digital Content?*:

What was the grade you gained for this work?

- Excellent
- Very Good
- Average
- Less than average
- Not marked

What is the type of this Digital Content?*

- Presentation
- Website
- Blog
- Wiki
- YouTube
- Song or Music track
- Facebook Page
- Photos
- PDF Document
- MS Word Document
- Computer Software
- Database
- iPhone/iPad Application
- Others

If your work is available online, please provide the web link.:

Can this Digital Content be used as Learning Content? (i.e: to help others learn something)

- Yes
- No

Question 20 is repeated three times

Do you have more Digital Content created for educational purposes and you would like to tell us about?*

- Yes
- No

Do you have more Digital Content created for educational purposes and you would like to tell us about?*

- Yes
- No

---

23) Please tell us more about other Digital Content you have created. Add title, unit name and link, if available, to each content into one line.

Thank You!

APPENDIX E:
ONLINE SURVEY – CYCLE 2 OF ITERATION 1

University of Western Sydney Student-Generated Content - Autumn 2013

Background

1) Please enter the following information:*

Name:

Student ID:

School :

2) Please enter your age group*

- under 18
- 18-24
- 25-34
- 35-54
- 55+

3) What is your gender?*

- Male
- Female

4) How would you describe your competency in using technology?*

- Strong competency
- Average competency
- Less than average
- Not competent

5) Do you have your own*

	Answer		Link (optional)
	Yes*	**No***	
Website/page	( )	( )	
Web Blog	( )	( )	
Wiki	( )	( )	
Photos or artwork collection	( )	( )	
YouTube channel	( )	( )	
Others (provide details in the blank)	( )	( )	

6) How many hours on average do you spend using the Internet?*

- ○ Less than 3 hours a day
- ○ 4 to 7 hours a day
- ○ 8 to 11 hours a day
- ○ More than 11 hours a day

7) Are you an Australian resident?*

- ○ Yes
- ○ No

International Students

8) If you are not an Australian resident, please indicate in what country is your permanent resident?

[Drop down list of all countries in the world]

Information and Communication Technologies

9) Drag the terms that you are familiar with to the box on the right side.
Click and hold to drag terms from the left menu, and place in the box to the right.
*

- [ ] Creative Commons
- [ ] Open Learning
- [ ] Open Educational Resources
- [ ] MIT-OCW (Massachusetts Institute of Technology Open Course Ware)
- [ ] Open Source Software
- [ ] Online copyrights issues
- [ ] Open Access Journals
- [ ] MOOC (Massive Open Online Course)

10) This part asks you about your experience with using information and communication technology tools for non-educational purposes.
Please indicate: How often you have used technology in each category over the past year. If you have never used a particular technology category, select Never.*

	Daily	Very often	Occasionally	Never
Participating in online forums	○	○	○	○
Creating YouTube clips	○	○	○	○
Creating websites	○	○	○	○
Using Twitter	○	○	○	○
Using social networking websites (e.g: Facebook)	○	○	○	○
Blogging	○	○	○	○
Creating and managing ePortfolio	○	○	○	○

	Daily	Very often	Occasionally	Never
Creating Wikis	○	○	○	○
Rating products online	○	○	○	○
Uploading mobile photos	○	○	○	○
Creating Presentations	○	○	○	○
Creating and managing Databases	○	○	○	○
Adding product review comments	○	○	○	○
Writing documents	○	○	○	○
Sending SMS	○	○	○	○
Creating graphics	○	○	○	○
Uploading digital camera photos	○	○	○	○
Composing music	○	○	○	○
Developing iPhone/iPad applications	○	○	○	○
Playing games	○	○	○	○
Watching movies on the internet	○	○	○	○
Listening to music on the internet	○	○	○	○
Participating in online study groups	○	○	○	○

11) What other types of online activities you are involved in ?

Authoring tools

12) The following table contains a list of tools which could be used in generating digital online content. Please indicate your skill level with each tool, the ten stars means you are professional in using most of tool's functions, and one star means you know very little. Leave the tool unrated if you have never used the tool:

Click on the stars to select your ratings.*

	Your skills level
Adobe Photoshop	
Audacity	
Flash	
Microsoft FrontPage	
Microsoft PowerPoint	
Microsoft Publisher	
Microsoft Word	
Paint.NET	
Programming languages	
Windows Movie Maker	
iBook Author	
iMovie	
Databases	
Others	

13) If there are other tools that you are skilled at, please tell us about these tools. We also would like to know how skilled you are in using these tools.

Experience with Digital Content production

14) In your own free time, have you created Digital Content that can be published on the internet? for example, have you created a presentation, YouTube clip, Facebook page, Web Blog, Website, ...etc.*

- ○ Yes
- ○ No

---

15) Please complete the following questions related to your Digital Content*

What is the name of this Digital Content?: ____________________

What is the type of this Digital Content?

- ○ Presentation
- ○ Website
- ○ Blog
- ○ Facebook Page
- ○ Wiki
- ○ YouTube
- ○ Song
- ○ Photos
- ○ PDF Document
- ○ MS Word Document
- ○ iPhone/iPad Application
- ○ Others

Can this Digital Content be used as Learning Content? (i.e: to help others learn something)

- Yes, it is a learning content
- Maybe, it contains some information
- Not really, it's for entertainment
- No

If your work is available online, please provide the web link.:

Question 15 was repeated once

Add more examples of your work in this area, digital content can be many different things that you have created and shared online. We are interested to know more about your work.:

Incentives to create and share

16) Creating and sharing digital content online can help others learn. Incentives to create and share can be different from one person to another. Please rank the following incentives according to your own experience with creating online content, 100 means this is a strong incentive to me, and ZERO means this is not an incentive to me:*

To help others learn new things	**0 -------------------------- 100**
Sharing my knowledge	**0 -------------------------- 100**
Popularity and fame	**0 -------------------------- 100**
Money and awards	**0 -------------------------- 100**
Academic publishing	**0 -------------------------- 100**
Being connected with others	**0 -------------------------- 100**
Building my e-Portfolio	**0 -------------------------- 100**
Autonomy and taking full authorship of my work	**0 -------------------------- 100**

Digital Content for educational purposes

17) Have you created Digital Content before in any of your study units for educational purposes, for example projects, assignments, presentations, documents or any kind of Digital Content?*

- Yes
- No

---

18) Please complete the following questions related to your Digital Content*

What is the name of this Digital Content?:

What is the name of the study unit for which you have created the Digital Content?:

What was the grade you gained for this work?:

What is the type of this Digital Content?

- Presentation
- Website
- Blog
- Facebook Page
- Wiki
- YouTube
- Song
- Photos
- PDF Document
- MS Word Document
- iPhone/iPad Application
- Others

If your work is available online, please provide the web link.:

Question 18 was repeated once

Add more examples of previous projects and/or assignments that you have used digital technologies to create. We are interested to know more about your work.:

Thank You!

APPENDIX F:
ONLINE SURVEY (1) CYCLES 3, 4 & 5 OF ITERATION 2

University of Western Sydney **Student-Generated Content-Spring 2013**

Background

1) Please complete your details below:

Name*:

Student ID*:

School*

- School of Business
- School of Computing, Engineering and Mathematics
- School of Education
- School of Humanities and Communication Arts
- School of Law
- School of Medicine
- School of Nursing and Midwifery
- School of Social Sciences and Psychology
- School of Science and Health

Age group*

- under 18
- 18 - 24
- 24 - 34
- 35 - 54
- 55+

Gender*

- Male
- Female

Please indicate your cumulative GPA*

0 ________________________[__]_____________________________ 7

2) Are you an Australian resident?*

- Yes
- No

International Students

3) If you are not an Australian resident, please indicate in what country is your permanent resident?

[Drop down list of all countries in the world]

General ICT Competency

4) How would you describe your competency in using technology?*

- Strong competency
- Average competency
- Less than average
- Not competent

5) Which computer Operating System that you are most familiar with*

- Microsoft Windows
- Apple Macintosh
- Both (MS-Windows and Apple Macintosh)
- Others
- I don't know

6) <u>Excluding</u> studying and research, how many hours on average do you spend using the Internet?*

- ○ Less than 3 hours a day
- ○ 4 to 7 hours a day
- ○ 8 to 11 hours a day
- ○ More than 11 hours a day

7) Do you have your own*

	Answer		**Link (optional)**
	Yes*	**No***	
Website/page	( )	( )	
Web Blog	( )	( )	
Wiki	( )	( )	
Photos or artwork collection	( )	( )	
YouTube channel	( )	( )	
Others (provide details in the blank)	( )	( )	

8) Drag the terms that you are familiar with to the box on the right side.
Click and hold to drag terms from the left menu, and place in the box to the right.
*

- [ ] Creative Commons
- [ ] Open Learning
- [ ] Open Educational Resources
- [ ] MIT-OCW (Massachusetts Institute of Technology Open Course Ware)
- [ ] Open Source Software
- [ ] Online copyrights issues
- [ ] Open Access Journals
- [ ] MOOC (Massive Open Online Course)

Information and Communication Technologies

9) This part asks you about your experience with using information and communication technology tools for non-educational purposes.
Please indicate: How often you have used technology in each category over the past year. If you have never used a particular technology category, select Never.*

	Daily	Very often	Occasionally	Never
Participating in online discussion boards	○	○	○	○
Creating Video but not sharing them on the Internet	○	○	○	○
Creating Video and sharing them on the Internet (i.e: YouTube)	○	○	○	○
Creating websites	○	○	○	○
Re-tweet messages on Twitter	○	○	○	○
Like what others' posts on social networking websites	○	○	○	○
Blogging	○	○	○	○
Creating Wikis	○	○	○	○
Rating products online	○	○	○	○
Creating Presentations for study/work purposes without sharing on the Internet	○	○	○	○
Creating Presentations and share on the Internet	○	○	○	○
Writing documents without sharing on the Internet	○	○	○	○
Writing documents and share on the Internet	○	○	○	○
Creating graphics without sharing on the Internet	○	○	○	○

	Daily	Very often	Occasionally	Never
Creating graphics and share on the Internet	○	○	○	○
Composing music without sharing on the Internet	○	○	○	○
Creating graphics without sharing on the Internet	○	○	○	○
Creating graphics and share on the Internet	○	○	○	○
Composing music without sharing on the Internet	○	○	○	○
Composing music and share on the Internet	○	○	○	○
Developing iPhone/iPad applications	○	○	○	○
Playing games	○	○	○	○
Watching movies on the internet	○	○	○	○
Listening to music on the internet	○	○	○	○
Creating tweets on twitter	○	○	○	○
Downloading learning resources from the internet without sharing them	○	○	○	○
Downloading learning resources from the internet and share with peers	○	○	○	○
Using social networking (i.e: Facebook, Twitter) to participate in TV programs	○	○	○	○
Commenting others' posts on social networking websites	○	○	○	○
Publishing your creative work online	○	○	○	○

	Daily	Very often	Occasionally	Never
Shopping online	○	○	○	○
Watching news channels online	○	○	○	○
Reading news online	○	○	○	○
Publishing your creative work online	○	○	○	○
Shopping online	○	○	○	○
Watching news channels online	○	○	○	○
Reading news online	○	○	○	○
Managing your trips online (i.e.: flights, accommodation,..etc)	○	○	○	○
Managing your trips online (i.e.: flights, accommodation..etc) and add your reviews to travel websites	○	○	○	○
Using chatting application to talk with peers to manage study/work (e.g.: Skype)	○	○	○	○
Taking online course outside university	○	○	○	○

10) What other types of online activities you are involved in ?

Authoring tools

11) The following table contains a list of tools which could be used in generating online digital content. Please indicate your skill level with each tool, the ten stars means you are professional in using most of tool's functions, and one star means you have never used that tool before.

Click on the stars to select your ratings.*

	Your skills level
Adobe Photoshop	
Audacity	
Adobe Flash	
Microsoft FrontPage	
Microsoft PowerPoint	
Microsoft Publisher	
Microsoft Word	
Paint.NET	
Programming languages	
Windows Movie Maker	
iBook Author	
iMovie	
Databases	
Wiki	
Blog	
Vimeo	
Google Docs	
YouTube to edit video	
Prezi	
Scoop.it	
Others	

12) If there are other tools that you are skilled at, please tell us about these tools. We also would like to know how skilled you are in using these tools.

Experience with Digital Content production

13) In your own free time, have you created something that can be published on the internet (i.e:Digital Content)? for example, have you created a presentation, YouTube clip, Facebook page, Web Blog, Website ...etc.*

- Yes, I've created more than 10
- Yes, I've created a few
- No, I've never created Digital Content

---

14) Please complete the following questions related to one of your Digital Content

What is the name of this Digital Content?*:

What is the type of this Digital Content?*

- Presentation
- Website
- Blog
- Facebook Page
- Wiki
- YouTube
- Song
- Photos

- PDF Document
- MS Word Document
- iPhone/iPad Application
- Others

Can this Digital Content be used as Learning Content? (i.e: to help others learn something)*

- Yes, it is a learning content
- Maybe, it contains some information
- Not really, it's for entertainment
- No

Is your digital content available online?*

- Yes
- No

Please add an online link for your work:

15) Add more examples of your work in this area, digital content can be many different things that you have created and shared online. We are interested to know more about your work.

Incentives to create and share

16) Creating and sharing digital content online can help others learn. Incentives to create and share can be different from one person to another. Please rank the following incentives according to your own experience with creating online content, 100 means this is a strong incentive to me, and ZERO means this is not an incentive to me:*

To help others learn new things	**0 -------------------------- 100**
Sharing my knowledge	**0 -------------------------- 100**
Popularity and fame	**0 -------------------------- 100**
Money and awards	**0 -------------------------- 100**
Academic publishing	**0 -------------------------- 100**
Being connected with others	**0 -------------------------- 100**
Building my e-Portfolio	**0 -------------------------- 100**
Autonomy and taking full authorship of my work	**0 -------------------------- 100**

Digital Content for educational purposes

17) Have you created Digital Content before in any of your study units for educational purposes, for example projects, assignments, presentations, documents or any kind of Digital Content?*

- ○ Yes, I've created more than 10
- ○ Yes, I've created a few
- ○ No, I've never created Digital Content

18) Please complete the following questions related to one of your Digital Content

What is the name of this Digital Content?*: ____________

What is the name of the study unit for which you have created the Digital Content?*:
____

What did you score on this Digital Content?*

- Excellent
- Very Good
- Good
- Average
- Below Average
- Failed
- Not applicable

What is the type of this Digital Content?*

- Presentation
- Website
- Blog
- Facebook Page
- Wiki
- YouTube
- Song
- Photos
- PDF Document
- MS Word Document
- iPhone/iPad Application
- Others

Is your Digital Content available online?*

- Yes
- No

Please add an online link for your work:

19) Add more examples of previous projects and/or assignments that you have used digital technologies to create. We are interested to know more about your work.

Thank You!

APPENDIX G:
ONLINE SURVEY (2) CYCLES 3, 4 & 5 OF ITERATION 2

University of Western Sydney

Students' Experience in Learning Through Generating OER

Your Details

1) Please complete your details below:

Name*:

Student ID*:

School*

- School of Business
- School of Computing, Engineering and Mathematics
- School of Education
- School of Humanities and Communication Arts
- School of Law
- School of Medicine
- School of Nursing and Midwifery
- School of Social Sciences and Psychology
- School of Science and Health

Age group*

- under 18
- 18 - 24
- 24 - 34
- 35 - 54
- 55+

Gender*

- Male
- Female

Please indicate your cummulative GPA*

- High Distinction
- Distinction
- Credit
- Pass
- Conceded Pass
- Fail

Your Learning Resource details

2) What is the title of your Learning Resource that you have created this unit (i.e: Major Activity, Learning Module)*

3) What is the software tool(s) that you have used to generated the Learning Resource in this unit?*

4) What would you expect to score after your teacher finish marking your Learning Resource? 7 stars= Excellent score|| 6 stars= Very good score|| 5 stars= Good score|| 4 stars= Average score|| 3 stars= Slightly less than average|| 2 stars= Less than average|| 1 stars= Very bad

	Learning Resource - Student's evaluation
Technicality and Design	
Educational Value	
Open for others to learn from	

5) Would you like to share your work online?

○ Yes

○ It's already online

○ No

6) Would you say that

○ You've spent more time on the learning content and less time on learning the software tool you have used to build the learning resource

○ You've spent less time on the learning content and more time on learning the software tool you have used to build the learning resource

○ You've spend equal amount of time on both the learning content of your learning resource and the software tool you have used to build it

7) Which Creative Commons license you have used/you would use for your learning resource?
*Click on the image to select a license**

CREATIVE COMMONS LICENSES

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Attribution-NonCommercial-ShareAlike

Attribution-NoDerivs

Attribution-NonCommercial-ShareAlike

Learning Experience through Generating Learning Resources

8) Authorship and learning by teaching in creating learning resource

I like the idea of creating learning resources, and share my knowledge with other students*

0 __________________________[__]________________________________ 10

Generating learning resources helped me to understand the topic more than any other module in the unit.*

0 __________________________[__]________________________________ 10

I like the idea of ownership of my work and being able to access it and improve it even after the end of the semester.*

0 __________________________[__]________________________________ 10

Generating learning resources is a very effective way for learning. I think if this strategy adopted in other units I will be able to understand the subject better*

0 __________________________[__]________________________________ 10

Generating learning resources added extra work for me that was not necessary.*

0 __________________________[__]________________________________ 10

I don’t think I understood the module which I developed a learning resource for better that other modules.*

0 __________________________[__]________________________________ 10

I don't like the idea of generating learning resources because I am unable to teach what I learned*

0 ________________________[__]_____________________________ 10

I think creating learning resources for a study topic increased my level of understanding of that topic*

0 ________________________[__]_____________________________ 10

I think I have created excellent learning resource, and I hope that future students will use to understand the unit modules.*

0 ________________________[__]_____________________________ 10

9) Overall I would say that I enjoyed studying this unit*

0 ________________________[__]_____________________________ 10

Workshops

10) Have you attended the workshops
(Reminder: The introduction workshop at beginning of semester and/or the Wordpress workshop)*

○ Yes

○ No

11) Workshops conducted during the semester to help you with creating the learning resource*

The workshops conducted during the semester were very helpful and greatly helped me in creating the learning resource.*

0 ________________________[__]_____________________________ 10

The workshops raised awareness of importance of Open Educational Resources in my learning experience.*

0 ________________________[__]_____________________________ 10

The workshops raised awareness of importance of Creative Commons licenses in my learning experience.*

0 ________________________[__]____________________________ 10

The workshops were not informative I didn’t know what they were talking about.*

0 ________________________[__]____________________________ 10

The workshops were not helpful, I am not sure if I understand what Open Educational Resources are.*

0 ________________________[__]____________________________ 10

Discussion Board

12) Which of the following statements you agree with regarding unit Discussion Board*

- ○ The discussion forums were very helpful and engaging and helped me greatly in understanding how to accomplish each stage in creating learning resource.
- ○ The discussion forums were helpful, somehow engaging.
- ○ The discussion forums were not helpful at all.
- ○ I haven’t used the discussion forums

Learning Resource Card

13) Which statement of the following you agree with regarding usability and structure of Learning Resource Card*

- ○ The Learning Resource Card was well structured and clear to follow.
- ○ It was easy to complete the Learning Resource Card, there were sufficient instructions and an example provided to help with completing the card.
- ○ The Learning Resource Card was well structured but needs more explanations and instructions, I found it difficult to use without getting back to my teacher for clarification.
- ○ The Learning Resource Card was not structured at all, and was very difficult to complete even with guidance from my teacher.
- ○ I haven't used the Learning Resource Card

14) Which statement of the following you agree with regarding the need to a Learning Resource Card in designing and planning for your learning resource*

- The Learning Resource Card helped me greatly to generate an initial draft and organized my project planning.
- The Learning Resource Card helped me to generate an initial draft but it wasn't helpful in planning my project
- The Learning Resource Card was not useful and I find it not important in developing my learning resource
- I haven't used the Learning Resource Card

Previous skills in using software tools

15) Which one of the following statements describes your experience with creating learning resource (i.e.: Major Activity, Learning Module)*

- My previous skills in using the internet and computer software helped me to quickly start my learning resource.
- My previous skills in using the internet and computer software were average and I needed help in using software authoring tools to create the learning resource.
- My previous skills in using the internet and computer software were very humble and I needed lot of support and guidance in using software authoring tools to create the learning resource.

Overall review

16) Overall, how would you describe your experience in generating Learning Resource project in this unit?*

Engaged me in this unit*

0 ________________________[__]_____________________________ 10

I learned about new things such as Open Educational Resources and Creative Commons Licenses*

0 ________________________[__]_____________________________ 10

The unit has developed new skills for me such as using new software applications and tools*

0 ________________________[__]____________________________ 10

I become to know how to use Creative Commons license to maintain intellectual property of my future work.*

0 ________________________[__]____________________________ 10

Learning through generating learning resources is an effective way in learning, because I was able to deeply understand the topic which I developed the learning resource about.*

0 ________________________[__]____________________________ 10

Thank You!

APPENDIX H:
UNIT COORDINATOR INTERVIEW QUESTIONS

University of Western Sydney

Interview

Researcher: Mais Fatayer
m.fatayer@uws.edu.au
School of Computing, Engineering and Mathematics

Perspectives of the unit coordinators on the integration of the OER development model in the learning environment, and further evaluation of the model.

1. How was the performance and engagement of students comparing with previous years? and how did the students benefited from this experience?
2. What are your implications for the use of the learning scaffolding including workshops, learning resources card and discussion forums?
3. Where improvements can be done?
4. How did you find the quality of student-generated learning resources in this semester comparing with last semester?
5. What do you think of future project of converting the unit textbook into an ebook, based on OER development model?

Thank you

APPENDIX I:
EVALUATION CRITERIA OF STUDENT-GENERATED LEARNING RESOURCES

		Description of criteria	Excellent=3 Stars	Good=2 Stars	Limited=1 Star	Poor=0	Score
Technical	Design and Presentation	The **graphical user interface** (GUI) evaluates the learning resource level for consistency in using fonts, colours and images. It also looks into the efficacy of integrating graphics, text, video and audio media.	The learning resource demonstrates a high level of consistency in the use of fonts, colours and images. It also shows effective integration of graphics, text, videos and audio media.	The learning resource demonstrates consistency in the use of fonts, colours and images. It integrates graphics, text, videos and audio media.	The learning resource demonstrates the use of fonts, colours and images. However, it lacks integrating one or two component that have been used The learning resource will show better design in graphics, text, videos and audio media.	Some attempts have been made to demonstrate the use of font, colours and images, however, there is a lack of consistency. It also shows poor integration of graphics, text, videos and audio media.	
		Interactivity is the learning resource that promotes constructive activity and provides users with sufficient control and level of interactivity. The learning objects provide rich activities that open up opportunities for action, rather than prescribed pathways of learning.	The learning resource demonstrates a high level of interactivity and constructive activities, provides users with sufficient controls and responds correctly to user actions.	The learning resource demonstrates constructive activities, provides users with some control, and responds to user actions.	The learning resource demonstrates constructive activities. Users have limited control as they go through the learning resource, or it is deficient in responding to their actions.	The learning resource provides limited or no activities. Users have very limited control as they go through the learning resource. It is deficient in responding to their action.	
		Navigation is the learning resource that is clear and easy to navigate throughout the learning resource. It is always understood where you are and where to go next, and learners are in full control of their navigation and use of the resource.	The learning resource provides complete guidance in how to navigate throughout the learning resource. It is always clear where you are and where to go next, and learners are in full control of their navigation and use of the resource. It exceeds the criteria with proper navigation options.	The learning resource provides guidance on how to navigate throughout the learning resource. It is always clear where you are and where to go next, and the learners are in control of their navigation and use of the resource.	The learning resource provides average guidance on how to navigate throughout the learning resource. Sometimes it shows where you are and the learners is limited in controlling their navigation and use of the resource.	The learning resource provides limited or no guidance on how to navigate the learning resource.	

		Description of criteria	Excellent=3 Stars	Good=2 Stars	Limited=1 Star	Poor=0	Score
Technical	Reusability	**Interoperability** is a interoperable learning resource that can be used in different environments, such as learning management systems, web browsers and operating systems without the need for additional software.	The learning resource is interoperable and can be used in any environment.	The learning resource is interoperable and can be used in any environment, however it may require a free plug-in.	The learning resource is interoperable but requires software to be downloaded. However, the software is freely available on the internet.	The learning resource is limited to a particular operating system environment and requires software to be downloaded, which may not be available free-of charge or needs to be purchased.	
		Decomposable is a flexible learning resource that can be decomposed into its basic components. For example, script, text, diagrams, images, charts, tables, audio, narrative and video components can be extracted separately.	The learning resource is flexible and can be decomposed into its basic components.	The learning resource is flexible and can be decomposed into its main learning objects, however, it contains few parts that are not decomposable.	Some components can be decomposed, however, it requires professional skills to use (e.g. programming skills).	The learning resource is not flexible to be decomposed and only limited components can be reused.	
		Cohesion is the learning resource that encapsulates all information and learning material in the same learning resource without referring to external resources.	The learning resource encapsulates all information and learning material in the same learning resource without referring to external resources.	The learning resource encapsulates information and learning material in the same learning resource, but refers to few external resources.	The learning resource encapsulates part of the learning material and refers to external resources in many situations.	The learning resource encapsulates little information and learning material in the learning resource, but the majority of the information refers to using external resources.	
		Granularity of learning objects in learning components is the learning resource with learning objects of relatively small file size (i.e. bytes) as the smaller the learning objects in a learning component, the easier the reusability.	All learning objects in a learning resource are of a small size and can be easily viewed and travelled (i.e. downloaded).	Some learning objects in a learning component are of a small size and can be easily viewed and travelled (i.e. downloaded), however, the learning resource consists of few learning objects of a large file size.	Few learning objects in a learning resource are of a small size, however, the learning resource consists of many learning objects of large file sizes.	Most of the learning objects in a learning resource have large size.	

		Description of criteria	Excellent=3 Stars	Good=2 Stars	Limited=1 Star	Poor=0	Score
Openness	Communities of Practice	The **use of an open licence** is a learning resource that is open and licensed in the least restrictive manner (e.g. asking for attribution only).	The use of most flexible or compatible licences (CC-BY).	Licensing can restrict commercial use and require new product to be associated with the same or compatible licences (CC-BY-SA, CC-BY-NC, CC-BY-NC-SA).	Most restrictive licences do not allow derivatives of the work with the same or compatible licences (CC-BY-ND, CC-BY-NC-ND).	Does not use any open licences or restricted to copyright licensing.	
Openness	Communities of Practice	**Aliveness** is a learning resource that continues to be alive and up-to-date by the original author or other contributors..	The learning resource has a history of updates that appear to be frequent. The learning resource allows others to contribute by adding or updating content.	The learning resource is updated occasionally. Allow feedback from others and closed for contributions to update The content.	The learning resource is rarely updated and does not allow feedback on updating content.	The learning resource has never been updated nor does it allow others to contribute to the content.	
Openness	Availability	A **teacher's trust** is how an educator foresees the learning resource as a valuable learning tool that can be incorporated in a particular study unit. For example, a teacher refers to it while teaching a related topic	Trust is a highly regarded learning resource for content to be used as a main reference while teaching the learning resource subject area. It encourages students to use it as a highly recommended reference that contains valuable content.	Trust is a highly regarded learning resource to be used as a secondary reference in teaching. It can suggest it to students as a supplementary reference.	Carefully trusting the learning resource for the content may suggest the student has a general idea from it.	The teacher does not trust the learning resource.	
Openness	Availability	A **learner's trust** is where the learner trusts that the learning resource contains correct and valid information to be used in critical time of studying, for example, as a final exams resources.	Trust is a highly regarded learning resource for content to be used as a main reference while studying or researching the learning resource subject area.	Trust is the learning resource used as a supplementary reference.	Carefully trusting the learning resource for the content can be used as one of the general references related to the study of the research area.	The leaner does not trust the learning resource.	

		Description of criteria	Excellent=3 Stars	Good=2 Stars	Limited=1 Star	Poor=0	Score
Educational	Content	**Content quality** consists of accuracy, non-biased presentation of ideas, sensitivity to cultural and ethnic differences using an appropriate level of detail. The learning resource provides comprehensive information effectively so that the target audience is able to understand the subject matter and connects important associated concepts within the subject matter.	The content is free of error and presented without bias or omissions that could mislead learners. Claims are supported by evidence or logical argument. Presentations emphasise key points and significant ideas with an appropriate level of detail. It connects important associated concepts within the subject matter. Differences among cultural and ethnic groups are represented in a balanced and sensitive manner.	The content is free of error and presented without bias or omissions that could mislead learners. It has some inaccuracies in making connections among main concepts within the subject matter.	The content has several errors related to accuracy of content, being biased or missed information that could mislead learners. Claims are not supported by evidence and there is no logical argument among the presentation of ideas. It also lacks the appropriate level of detail.	Content is inaccurate and there is no value of its content.	
		The **quality of exercises** applies to learning resources that provide an opportunity to deepen understanding, practice and strengthen specific skills and knowledge. Some learning resources require more exercises than others that need richer but fewer exercises. Quality of exercise criteria also includes richness of exercises, integration of different skills, readability, errors free and answers keys.	Provide an opportunity to deepen understanding, as well as practise and strengthen specific skills and knowledge. All skills and knowledge that are assessed align clearly to the content. The exercises are also free from error and provide informative key answers.	All the skills and knowledge assessed align clearly to the content. However, it does not provide opportunities for understanding and practising specific skills and knowledge. The exercises are also free of errors and provide informative key answers.	The learning resource assesses some content but is limited when assessing the important concepts and knowledge. The exercises may contain few errors and feedback is not informative	The learning resource doesn't provide any exercises and fails to assess learner's knowledge.	

		Description of criteria	Excellent=3 Stars	Good=2 Stars	Limited=1 Star	Poor=0	Score
Educational	Structure	**Motivation** is defined as the ability to motivate and provide interest for an identified population of learners. The resource has the potential to motivate and generate interest in the subject that is addressed, as well as offer a representation of reality-based content through multimedia, interactivity, humour, drama and/or challenges through games that stimulate student interest.	The learning resource engages the learner by asking questions and waiting for feedback from the learner either throughout the learning resource or at the post-test (i.e. quiz at the end). The learning resource also motivates learner to explore more in the subject area	The learning resource engages the learner by providing questions throughout the learning resource. There are clear motives for the learners to explore the subject area.	The learning resource provides weak opportunities to engage and motivate learners. Limited questions are available throughout the learning resource. The learner is engaged by providing questions throughout the learning resource. There are clear motives for learners to explore further in the subject area.	The learning resource fails to engage and motivate learners due to a lack of questions and motivation for learners to explore the subject area.	
		Alignment to objectives represents strong alignment among learning objectives, activities, assessments and learner characteristics. The learning resource must provide content and activities appropriate to the goals and intended audience level applicable to assessments and learning activities. Learning resources that verify this criterion must state learning objectives at the beginning of the material.	Strong alignment among learning objectives, activities, assessments and learner characteristics. The learning resource provides content and activities appropriate to the goals and intended audience level, and matches among assessments and learning activities. The learning resource states learning objectives at the beginning	There exists alignment among learning objectives, activities, assessments and learner characteristics. The learning resource provides content and activities appropriate to the goals and intended audience level, as well as matches assessments with learning activities. The learning resource emphasises learning objectives at the beginning.	There exists weak alignment among learning objectives, activities, assessments and learner characteristics. The learning resource provides content and activities somehow appropriate to the goals and intended audience level, match among assessments and learning activities. However, it may not state learning objectives at the beginning.	The learning resource does not state learning objectives.	

		Description of criteria	Excellent=3 Stars	Good=2 Stars	Limited=1 Star	Poor=0	Score
Educational	Structure	**Referencing** applies to a learning resource that provides a complete references list at the end. Referencing helps increase confidence in the learning content and allows learners to easily identify and locate original resources and evidence that the author of the learning resource has built links across knowledge, intelligent selection and analysis of previous works.	The learning resource provides a complete reference list at the end. References are recent and used successfully to build links with previous knowledge.	The learning resource provides a complete references list at the end. Some references are recent and relevant, however, the majority is outdated. There is a well established link with prior knowledge.	The learning resource provides very few references and all references are not recent. Furthermore, there is no clear link between the references and knowledge presented.	The learning resource does not provide references.	