AN INVESTIGATION UNCOVERING HOW STUDENTS AND HOW TUTORS DESIGN LEARNING OBJECTS FOR NOVICE STUDENTS TO USE WHEN ACQUIRING ESTABLISHED RESUSCITATION KNOWLEDGE.

ALAN RICHARD WILLIAMS
B.A., Registered Nurse,
M.Sc, P.G.C.H.E

Thesis submitted to

The University of Nottingham

for the degree of

Doctor of Health Science.

Abstract

Higher education in the twenty-first century is experiencing transformational change due to the advances in technology, with this period referred to as the Fourth Industrial Revolution – the Information Age. Just as the three previous revolutions created step changes in society so will this one, and as the changes now are occurring over a much shorter time period academics, educators and universities have less time to understand and respond to these events. The three key technological changes are firstly the availability, power and pervasiveness of computers, secondly the development of the Internet and finally how these factors have affected knowledge and learning, in the new millennium.

These changes in the Information Age have influenced learning theories and learners, with the rapidity meaning there is less time to consider and investigate how technology can be used to enhance student learning in higher education. The opportunities technology provide to improve student learning in higher education range from the design of small educational resources to overarching curricula and educational organisations themselves. This work investigated the design of small educational resources called learning objects and in particular, the storyboard creation aspect of this process and then the educational gains achieved from using said resources. The established knowledge of resuscitation was a suitable vehicle to investigation the design of learning objects as it has a strong internationally accepted theoretical foundation and nurses are required to learn this knowledge as part of their pre-registration education.

The Storyboard Workshop (phase 1) of this research investigated how learning objects are designed by nursing students (n=7) and by tutors (n=6), by applying Tuckman's stage of group development model revealing how each homogenous group functioned and what twelve pedagogical factors student-designers and tutor-designers felt important when analysed using the Learning Object Attributes Metric (LOAM) Tool. In the Learning and Evaluation (phase 2) of this investigation, novice nursing student were randomly assigned to view either the student-designed (n=58) or tutor-designed (n=61) learning object to acquire established resuscitation knowledge with the learning gain and acceptability of the resource viewed, assessed.

The results of phase 1 revealed student-designers and tutor-designers generally discussed similar LOAM pedagogical factors though students spent more time discussing navigation and tutors focussed on the objective. When Tuckman's model was applied the student-designers spent significantly less time forming and storming and significantly more time performing than the tutor-designers, suggesting when designing learning objects on established knowledge, students focus on the task whereas tutors may refer to professional experience that may distract from the design process.

Phase two demonstrated irrespective of the designers, viewing either the student-designed or tutor-designed learning object conferred significant learning gains when pre and post viewing (knowledge, student-designed 4.3 to 8.3, $p=.000$; tutor-designed 4.4 to 8.2, $p=.000$ and confidence in knowledge, student-designed 5.4 to 7.5, $p=.000$; tutor-designed 5.3 to 6.9, $p=.000$) was assessed. However, the difference in confidence in knowledge significantly favoured the student-designed resource (2.1 v 1.5, $p=.042$), though both resources were very positively evaluated.

In the design of a learning object it may be the student-designers are more attuned to their peers needs, and this effect could be exploited by ensuring students are integral in the design of a learning object for novice student to use when acquiring established knowledge. In addition, this effect may be applicable with projects to design learning objects for novice learners to acquire established knowledge, whether this has a clinical focus or for novice students in non-healthcare disciplines.

Acknowledgements

I am extremely grateful to many people for their support during my studies. Without their patience, support and advice I would not have achieved nearly as much.

My supervisors Dr Richard Windle and Professor Heather Wharrad have been available and provided constant advice and support and with the participants, members of the HELM Team particularly James Henderson and Mike Taylor, nursing students (now Registered Nurses) Donna Hinchcliffe and Charlotte Underhill who reviewed the final RLOs and colleagues in the School, this investigation would not have been completed. In addition my thanks to Dr Andrea Venn for statistical advice, colleagues in the School of Health Sciences, funding from the University Cascade Fund (was Alumni Fund) and Dr Richard Lilley from Tracksys on the use of Observer™ software.

Most gratitude must be for my family, particularly my wife Liz Williams and children Amy and Toby who have stood by and supported me throughout this journey. They may not quite realise how or what they have done, though their contribution has been immense and without this, I would have been lost.

Thank you one and all.

Contents

Glossary

ALS	**Advanced Life Support** A general term used to refer to more advanced levels of resuscitation care. The Advanced Life Support Course accredited by the Resuscitation Council (UK) provides a nationally recognised certificate for health professionals in resuscitation interventions.
BLS	**Basic Life Support** Basic life support refers to maintaining airway patency and supporting breathing & circulation without the use of equipment other than a protective device (Resuscitation Council 2015b).
Blended Learning	Learning achieved by direct contact with tutors and the use of e-learning resources.
CPR	**Cardio-pulmonary resuscitation** (Also cardiopulmonary resuscitation or cardio-pulmonary resuscitation.) See **BLS.**
Established Knowledge	Knowledge with strong theoretical foundations widely accepted by a discipline.
HEFCE	**Higher Education Funding Council for England**
HELM	**Health E-Learning and Media** Term used to refer to a group of academics and learning technologists based in the School of Health Sciences, University of Nottingham.
ICT	**Information, Communication and Technology**
JISC	**Joint Information Systems Committee** now commonly referred to by the acronym **JISC**.
Learning Technologist	An evolving job title describing staff involved in education including new specialists in learning technology or academics who have developed keen interest in learning technology and support (Oliver 2002).
LMS	**Learning Management System** A system that facilitates learning including hosting resources, administrative tools and web-based tools for education.
LO	**Learning Object.** Any digital resource that can be used to support learning (Wiley, 2000) and see Section 1.3.3.3. Also see RLO.
MOODLE	**Modular Object-Orientated Dynamic Learning Environment** A commonly used virtual learning environment (VLE) in education.

NSS	**National Student Survey** An annual survey completed by final year undergraduate students in the United Kingdom.
OER	**Open Educational Resource** A term used to describe educational resources that can be accessed without cost. (The Open University, 2018.)
RLO	**Reusable Learning Object.** Reusable learning object. See LO in Glossary and section 1.3.3.3.
Social Media	Websites and applications that enable users to create and share content or to participate in social networking (NMC (2015a).

1 Introduction

1.1 Overview

This research investigates how students and how tutors design digital learning resources by examining how they function as a homogenous group and what pedagogical decision are made during the design process (Storyboard Workshop, phase 1 of this investigation). The student-designed and tutor-designed learning objects were then developed by the researcher, with the Learning and Evaluation (phase 2) determining the learning effect and acceptability of each resource when used by junior nursing students to acquire established resuscitation knowledge. By establishing how designers function and what pedagogical decision were made by each group during the storyboard workshop, and then establishing the learning effect and acceptability of digital educational resources, an understanding into how students and separately tutors produce these types of learning resources was achieved. If there are features of each groups' design that enhance the acquisition of knowledge taken from a knowledge-base that is already accepted by a discipline, in this case around basic life support technique I refer to as 'established knowledge' (see Glossary), future research can investigate if this effect is applicable elsewhere in nursing, with other disciplines and how this new knowledge can assist learning object designers.

This chapter will commence with a discussion of technology and explore how the development of computers and the World Wide Web have influenced and indeed changed society. The First and Second Industrial Revolutions that used fossil fuel then electricity to mechanise and create mass production, occurred over two centuries. However, the Third Revolution of computing and information technology that emerged in the middle of the twentieth century laid the foundation for today's Fourth Industrial Revolution (Schwab, 2015), where information and data are transforming society over a much shorter time period (Figure 1-1). This rapid progress has not allowed time for pedagogical practice to adapt to technology in the way other industries have had to do, though this investigation takes steps in that direction.

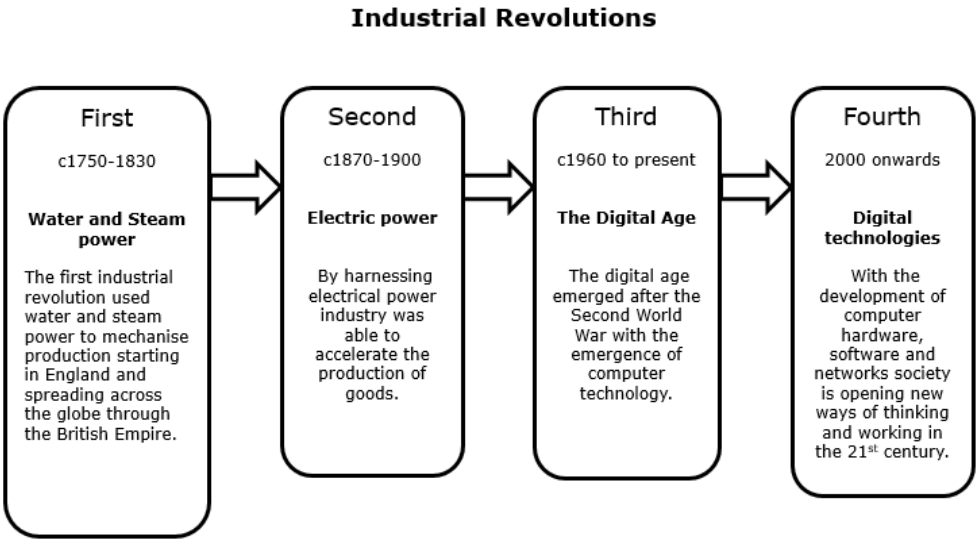


Figure 1-1 Industrial Revolutions
Figure 1-1 represents the four industrial revolutions from Schwab (2015), with an indication of when they occurred and the impact they had or may have on society.

First, these societal changes are ecxplained prior to a discussion of learning and learners with a description of three learning theories (behaviourism, cognitivism and constructivism), explaining why a social constructivist approach is most applicable to learning in the Information Age. The discussion will consider students and the use of learning objects in higher education, highlighting the important role of learning design and why the student voice needs to be heard in the design of these types of learning resource. The chapter will then explain why resuscitation was chosen as an appropriate vehicle for this research and why it is essential for nursing students to acquire this knowledge, before concluding with a summary drawing together the technology, learning and resuscitation discussion.

1.2 Technology within Society

It must be recognised that education does not function in a vacuum, but rather is influenced by, and reflects society as a whole. Therefore, in order to understand the place and role that technology has within higher education, and the potential impact of current trends and developments in the area of e-learning, such as the impact of student designers of learning objects, which is the focus of this study, it is necessary to take a step back and look at technology within society as a whole. Whilst many aspects of the Third and particularly the Fourth Industrial Revolution have affected education and education practice, three overarching areas can be said to have had the most influence.

Firstly, the rise of computing availability and power, including the functionality, accessibility and affordability of software and hardware, most recently exemplified in smart phones to access digital platforms and content. Secondly the rise of the World-Wide Web (herein referred to as the Web), the ubiquitous availability of information and the move towards the democratisation of information creation and ownership. Thirdly, changes in communication technology and the rise of the social media environment that has fundamentally changed human interactions with both other humans and arguably with knowledge itself. These three areas are discussed below (section 1.2.1-1.2.3) as technology is inextricably linked with and embedded in education in twenty-first century society.

1.2.1 **Computing power and availability**

Computer technology has developed since the second half of the twentieth century and has had an ever increasing impact on every aspect of society, including education. These advances were dependent on factors such as the availability of more powerful devices as predicted by Gordon Moore in 1965 (Henle & Hill, 1966; Moore, 1998) who identified

> "…the amount of processing power available at a given price will double every 18 months." (Hinckley & Wigdor 2012, p122).

This has proved surprisingly accurate and though the power of devices has reached a plateau in recent years (Flamm, 2017), technology continues to drive the boundaries of possibilities in all areas, but particularly in areas such as education that are traditionally limited by economic constraints. Weiser (1991) discussed the effect of "ubiquitous computing" where technology is seamlessly integrated into the environment emerging in the twenty-first century and these changes have made the use of digital technology within education a realistic possibility and even expectation for the majority of learners within higher education throughout the world (Brown, 2015). This has potentially good and bad effects, as the expectation drives demand, but can also lead to poorly designed or delivered materials to meet this ever increasing demand. However, the expanding and all-pervasive nature of technology in hardware (e.g. smart phones and tablets), software (e.g. applications and e-learning development tools) and the support structures (e.g. networks and the

Web), has influenced and revealed opportunities for education to take advantage of in order to enhance learning.

1.2.2 The Web

Alongside increasing computing power has been the transformative rise of the Web on society over the last 30 years with its invention by Sir Tim Berners-Lee in 1989 (World Wide Web Foundation, 2015). When the Web became accessible to the wider population it was a static information source users could access though not interact with content in a dynamic fashion (McClellan, Jacko, Sainfort & Johnson, 2012). The next iteration, referred to as Web 2.0 where users could avail themselves a range of software and tools in a far more dynamic fashion enabled the democratisation of information and heralded the arrive of user generated content (Conole, 2013; McClellan et al 2012; O'Reilly, 2007; Rosen & Nelson, 2008). The evolution continues through additional iterations and the recent emergence of Web 3.0 (Jiang, 2014; Rudman & Bruwer, 2016) where the integration of artificial intelligence applications facilitates the interrogation of Web data with no human involvement. The financial and reputational investment from businesses that have emerged from this technological revolution (e.g. Google™, Facebook™) and from established organisations such as the car industry that embeds Web functionality in their product or the "Internet of Things" in domestic products, demonstrates the Web has continued to evolve. The opportunities provided from Web 3.0 are yet to be fully exploited (Anon, 2016a) and there is no reason to think progress will stop or not affect higher education, though it is the dynamic user generated content of Web 2.0 this research investigated.

1.2.3 Social Interaction

Whilst the first mobile phone call, an embryonic electronic network and email use can be traced to the early 1970s and the development of the Web familiar to many today to the latter part of the twentieth century (Dix, 2012; Edelbring, 2010), dominant organisations in the Information Age such as Facebook™, YouTube™ and Twitter™, now integrated into the fabric of many societies were not then even in existence. Smart phones emerged in 2007 with the launch of the Apple iPhone that dramatically changed the way users interacted with their device through a responsive

touch screen (MacKenzie, 2013) with other companies soon developing their own versions.

It could be argued that an even bigger revolution in communication has arisen through the development and rise of social media platforms and subsequent applications such as Instagram, WhatsApp, SnapChat and similar. These applications differ from simple email communication in terms of the interactivity and immediacy as users can and perhaps expect to receive an immediate response such as a "like", often in the form of a pictorial representation of that emotion – an emoji. These developments have had major impact in the way individuals interact with society as a whole and arguably, even how they view society because of the immediacy and scale of interactions with other people. The Office for National Statistics (2016) reported almost three quarters of the UK adult population accessed the internet away from home or work in 2015 and it is under this lens that education must function. As education is part of society these developments impact hugely on learning and student expectations so education must also respond to these changes.

1.3 Learning and Learners

1.3.1 **Learning Theories**

Education has been an integral part of human existence since the Greek philosophers and earlier (Harasim, 2017), but it is only within the last 150 years that theories on learning have been formalised. Since the late nineteenth century three distinct, though to some degree overlapping schools of thought have emerged and are referred to as behaviourism, cognitivism and constructivism (Ertmer & Newby, 1993; Harasim, 2017; Woollard, 2011). In section 1.3.1 there will be a brief explanation of these three schools, followed by a justification why a social constructivist approach was the most appropriate theoretical foundation for this research.

1.3.1.1 Behaviourism

Behaviourism can be described as the learner reacting to conditions in the environment with little active seeking of knowledge. Notable authors in behavioural psychology include Thorndike, Pavlov and Skinner with the latter twoknown for designing animal experiments where a dog salivated in

response to a bell or rats were rewarded for performing pre-determined actions (Mitchell, 2015). When applied to humans an example of a behaviourist educational approach could be in learning to perform cardio-pulmonary resuscitation by a student replicating what a teacher demonstrated and receiving praise when they perform the skill as shown. The psychomotor skill of delivering chest compressions is learnt though the essential knowledge underpinning this aspect of resuscitation is not part of the learning process; consequently, a behaviourist approach is not associated with the acquisition of higher-level knowledge (Ertmer & Newby, 1993).

1.3.1.2 Cognitivism

Cognitivism is a more recent theory developed since the late 1950s where complex cognitive processes in learning were considered paramount, suggesting an individual's knowledge acquisition is mediated through memory, prior knowledge and experience (Kneebone & Nestel, 2011). The learner is much more involved in the knowledge acquisition process, with those who educate a student presenting information in as accessible a manner as possible. Presenting simple concepts to a learner by using mnemonics or concept maps is thought to stimulate more active learning (Ertmer & Newby, 1993; Mann, Dornan & Teunissen, 2011) and can be seen in many professional education environments such as "the ABC of resuscitation" (see section 1.4.1 & 1.4.2), that simplified the essential knowledge required to resuscitate an individual who has collapsed.

1.3.1.3 Constructivism

Constructivism's theoretical foundation is based on meaning created by the learner from their experiences when they work with a teacher or more experienced peer to acquire knowledge or skills. Two key proponents of constructivist theory are Jean Piaget who proposed learning followed a cognitive approach and Lev Vygotsky who believed social and cultural processes influenced learning (Schcolnick, Kol & Abarbanel, 2006). A range of subsequent derivations of constructivism included Cultural Historical Activity Theory (CHAT), philosophical and radical constructivism (Dennick, 2015) and Parkes (2002) suggested there were at least three other forms (physical, evolutionary post-modern and information-processing), though a

social constructivist approach is central to this thesis and will be discussed in section 1.3.1.4 below.

A constructivist view of learning according to Laurillard (2008) includes approaches adopted by educators who do not follow a didactic teacher-centred learning model and is congruent with adult learning theory popularised by Malcolm Knowles where the learners' experiences are valued and contribute to their education. With the advent of technology and the internet over the last quarter of a century, Ertmer & Newby (2013) updated their original article to reflect the effect this has had on learners and teachers, suggesting constructivism has become the pre-eminent learning theory in certain disciplines (medicine, law, architecture). They identify features of a constructivist approach include the student holding more control and the use of problem-solving skills by the learner.

A further extension of constructivism can be seen in connectivism, where learning is achieved by people connecting with others through interpersonal links and technology (Transue, 2013) though accepting connectivism is at still in its early stages of maturation as a formal theory (Paulin & Gilbert, 2016), constructivism provides much firmer theoretical foundations for this research.

1.3.1.4 Social Constructivism

Vygotsky's theory of social constructivism is based on the concept of a Zone of Proximal Development where the learner gained a deeper understanding by working with a more experienced peer or teacher who is able to assist the learner in bridging the gap (Cole & John-Steiner, 1980). Cook (2010a; 2010b) proposed technological tools amplify the role of the experienced peer or teacher in what he referred to as an Augmented Contexts for Development. Wheeler (2016) suggested in Vygotskian terms it may be the technology that is the experienced peer or teacher, though accepted a human designer has created the technology and this research investigated how designers function in a group and their pedagogical decisions when they designed learning objects. The social aspects of learning (e.g. discussion with others, activities, group problem solving) can be part of social constructivism and as with cognitivism, is a much more active learning process. Kinchin, Cabot, Kobus & Woolford (2011, p210) reported how they replaced a "medieval transmission model of higher

education" for dental students with one where the student and the tutor contribute to learning, based on a social constructivist approach. When applied to learning about resuscitation the student draws from their prior knowledge and experience whilst working with a more experienced peer or teacher to construct and develop their personal understanding of how to perform chest compressions thereby gaining a deeper understanding of the process.

Mann & MacLeod (2015) support this view saying constructivism and social constructivism is leading medical education where the tutor and student are partners in the learning process. They report investigations of "teamwork, inter-professional learning, identity formation and learning in the clinical setting" (ibid, p54) that used a social constructivist lens to understand processes that are central to the education of health professionals. Social constructivism also underpins current thinking on learning (Mann & MacLeod, 2015) with Bandura's social cognitive theory discussed later in this thesis (see section 2.2.2.4 and 5.2) and appears more able to meet the needs of a diverse cohort of students (Andrew & Ferguson, 2008; Jesse, Taleff, Payne et al, 2006). Though all students will acquire knowledge individually, they also acquire knowledge in groups, partly due to the use of problem-based learning (PBL) in health professional education (O'Brien, 2015). She goes on to explain how PBL emerged from constructivist learning theory where the student constructs knowledge with the assistance of a facilitator, rather than a teacher centred transmisive model of education.

Though the social aspect of learning is central to social constructivism, in a mixed group it is possible one voice will dominate discussion and influence pedagogical decisions made by participants. In addition, as a constructivist approach is based on the principle that learners create their own view of reality it was necessary to keep the student and tutor group of designers apart so their view of how a storyboard in the design of an educational resource was visible and not influenced by others. Because this investigation observed homogeneous groups (students or tutors) when they created a storyboard in the design of a learning object, the way each group functioned and their pedagogical decisions were attributable to those participants, with no possible influence from the other group. This made it

possible to determine what pedagogical decisions students and tutors made and was a key aspect of this investigation.

1.3.1.5 Learning Theories Overview

Haythornthwaite & Andrews (2011) suggests as disciplines may draw from more than one learning theory and there is a degree of similarity between the three schools, particularly the cognitivism and constructivism, a dogmatic view of learning as isolated theories is unhelpful. Consequently behaviourism, cognitivism and constructivism learning theories are perhaps better viewed as a Venn diagram (see Figure 1-2) with derivations of constructivism noted, perhaps evolving into a school in their own right. It should be acknowledged that theorising about learning continues, reflecting what is current at that time and Goldie (2016) suggested "…there is unlikely to be a single theory that will explain learning in technology enabled networks." though social constructivism is based on solid theoretical foundations. Consequently, a social constructivist approach to learning based on a Vygotskian, rather than a cognitive stance has been adopted and provided a secure theoretical foundation for this research.

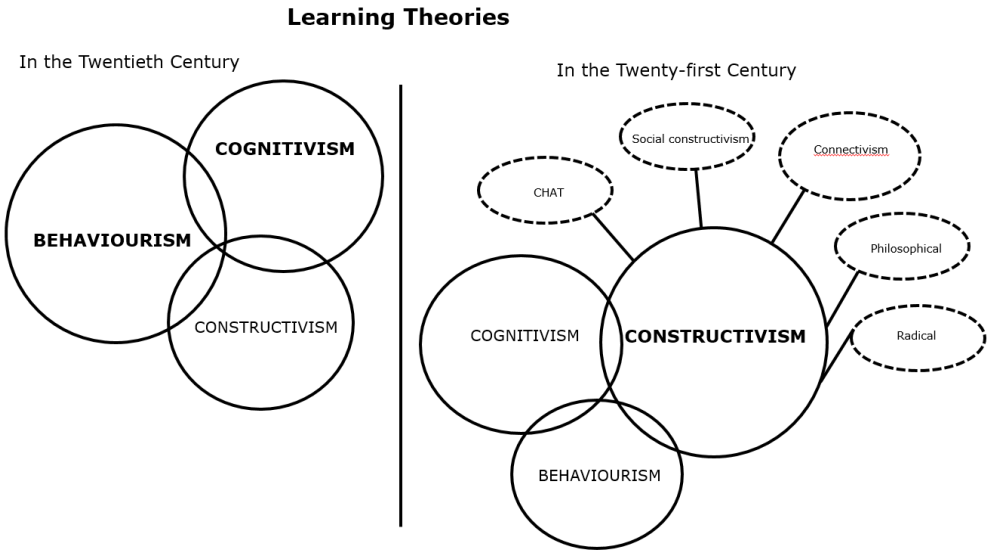


Figure 1-2 Learning Theories
Figure 1-2 displays learning theories in the twentieth and in the twenty-first century. With the influence of technology and students adopting a more vocal role in their education, a constructivist approach to education has become pre-eminent, with a social constructivist and a connectivist strand emerging along with others (e.g. philosophical constructivism, radical constructivism, Cultural Historical Activity Theory).

1.3.2 **Students in the Digital Learning Age**

It is necessary to understand the current landscape in higher education with Goodyear (2015) highlighting the need for learning design to assume a greater role in higher education whatever teaching and learning methods are used. Peter Goodyear explained there are four drivers of change challenging traditional educational practice; 1) diversified student needs and expectations, 2) technology, 3) employer expectations and 4) pressures on teaching staff, with the first two drivers (diversified student needs and technology) central to this research. It is particularly necessary to understand who the twenty-first century university student is, how technology can assist student learning and why the student voice in the design process may result in learning resources better aligned to their peers needs.

1.3.2.1 Diversified Student Needs and Expectations.

Individuals entering education are fundamentally different to previous generations, due to their access to technology and higher education must adapt to meet their needs. In addition, there are a greater number of students entering higher education today than two or three decades ago (Cable, 2012; Department of Business, Innovation and Skills, 2011;15;16; McGettigan, 2013) when the use of technology in society was in its infancy (see section 1.2) and education methods must evolve to take account of this. The 2013/2014 undergraduate population in higher education in England was over 1.7 million students (Higher Education Statistics Authority, undated) and a report by Lord Browne reported 45% of 18-30 years olds in England currently enter higher education, an increase from 39% ten years previously (Browne, 2010).

Students, particularly the so-called "Millennials" born since the 1980s (Chung & Fitzsimons, 2013; Hutchinson, Brown & Longworth, 2012; Lippencott, 2012) embarking on higher education in the first decades of the twenty-first century have grown up with the Web and therefore it is important to investigate how technology can be utilised to achieve more effective learning environment. In 2007 a report for DEMOS that investigated children's' learning in the digital age identified the dominant role technology played in their life and a proportion of these individuals have or are now about to enter post compulsory education (Green &

Hanlon, 2007). Conole (2008, p138) suggested technology is "… central to how they organise and orientate their learning." and educators must accommodate how students learn to enable them to reach their full potential, so it is essential to understand how they learn and what their needs are.

However, there is no definitive view that categorises individuals as belonging to a specific generation though Strauss and Howe (1997) discourse on the generations (referred to as a saeculum comprising four periods of approximately 20 years each) and historical events admittedly with an America focus, provides a starting point to understand the student in higher education today. In 2000 at the dawn of the Fourth Industrial Revolution, Baby Boomers would be in their mid-30s to mid-50s, Generation X in their mid-20s to mid-30s and Millennials as young children to young adults (see Table 1-1). Students from Generation X born between 1965 to the late 1970s (Hopkins, Hampton, Abbott et al, 2018; Gordon, 2010) have matured during the Information Age, experiencing those same changes in technology albeit at a different stage of their life as Millennials, who have known little else. Consequently a range of student undertaking higher education in the first decades of the twenty-first century are not surprised by and may well expect the use of technology in education.

Table 1-1 Summary of Generations

Generation	Year range born [Note 1] (approximate)	Age at the year 2000
Baby Boomer	1946-1964	36 to 54
Generation X	1965-1976	24 to 35
Millennials/Gen Y	1977-1995	5 to 23

Note 1 – The age range ascribed to each generation is an approximation based on literature from Gordon (2010), Hopkins et al (2018), Oblinger (2003) and Wikipedia (2018).

However, categorising learners by an age range alone creates stereotypes that may not truly represent the students currently in higher education with Holmes (2011) challenging a simplistic generational continuum approach by analysing young peoples' use of technology. Holmes analysis of young peoples' online activities revealed three types of user with one group embracing the information superhighway for educational and recreational purposes, a second group engaging primarily in recreational activities and the third group exhibiting a distinct lack of interest in online activity, using technology for homework and little else. A binary division categorising students currently accessing higher education as "digital

natives" and "digital immigrants" (Prensky 2001) may be too simplistic as Sharpe, Benfield, Lessner & DeCicco (2005) identify in their report for JISC and an editorial by Rachel Leaver suggested "natives" might be

> "…more comfortable with the technology but not necessarily having the skills to use it." (Leaver, 2012, p97).

What is more with UK access agreements and a widening participation agenda designed to open university entry to underrepresented groups in society (Matheson & Woodward, 2015; McGettigan, 2013), the university student population is more diverse and educators need to consider how learning resources can be designed to meet all students' needs.

A more active engagement by students reflecting a social constructivist approach in the design of learning as part of a curriculum group (Brooman, Darwent & Pimor, 2015 – *module on EU law*; Woolmer, Sneddon, Curry et al, 2016 – *interdisciplinary undergraduate science skills*) values their voice and is congruent with national policy in the UK (Department of Business, Innovation and Skills, 2011). A multi-institution Higher Education Academy report by Campbell, Eland, Rumpus & Shacklock, (2009) promoted the importance of respecting and embedding the student contribution to learning and curriculum design, with descriptive evidence of the advantages and challenges ahead. The involvement of students in the design of digital resources communicating established knowledge provides an opportunity to achieve meaningful student engagement in their learning (Rosen & Nelson, 2008) and a robust investigation of the design process and learning achieved as this study provides, will contribute to the evidence base on education practice.

Goodyear (2015) explains how what he terms "traditional teaching" in higher education is not fit for purpose in the Information Age where students use the technology they have to hand (laptops, tablets and smart phones) to access learning within and outside traditionally accepted structures of high education. He goes onto say "…teaching approaches that may have been the norm 20 or even 10 years ago no longer look affordable or appealing." suggesting the design of learning resources must be given much more prominence (Goodyear, 2015, p37). Essentially students should not be considered a homogenous group *au* fait with technology and do require support to navigate their learning journey, with

educational resources designed by their peers potentially making knowledge acquisition using a learning object more accessible.

1.3.2.2 Technology

The creation of digital learning resources is a function of the widespread availability of computer technology and software in the Information Age discussed in section 1.2. The National Union of Students report for the Higher Education Funding Council for England, HEFCE (2010) referred to the increasing percentage of homes in the UK who have access to the internet, from 51% in 2007 to 65% though whether access translates into use for educational purposes is unclear as Holmes (2011) identified. However, the National Student Forum highlighted the importance for higher education in the United Kingdom to embrace technology in teaching asking

> "…universities and lecturers to review their teaching methods and use of available systems to assess whether they are sufficiently taking advantage of new technologies to ensure that the approach is as accessible, engaging and as relevant as possible to the future world in which we are going to be working." (National Student Forum, 2009, p27).

Haythornthwaite, Andrews, Fransman & Meyers (2016, p9) explain how technology, in this case digital educational resources, are just like any other tool used for learning, and referred to transforming "…learning practice at individual, group, institution and societal levels." and this investigation could influence the design and use of learning objects at all these levels. Since 2012 the annual series of Innovating Pedagogy Reports (Institute of Educational Technology, 2017) have summarised the potential technology has had and how it is thought will continue to influence learning in the Information Age. Each annual report identified ten innovations in use though yet to fully influence educational practice (see Table 1-2 for list of innovations). Some of the innovations are only possible in the Information Age (e.g. MOOCs; Open Text Books) demonstrating the importance of technology in education as discussed by Peter Goodyear. Confirming the role technology plays in higher education, Brown (2015) identified six areas[1] where technology is integral to education demonstrating learners

[1] 1) Device ownership & mobile-first 2) textbook & open educational resources, 3) adaptive learning technology, 4) learning spaces, 5) the next generation learning management systems and 6) learning analytics & integrated planning & advising services.

are acquiring knowledge in a vastly different manner to students even one generation ago (Goodyear, 2015). Garrison (2017) highlighted the education system has perpetuated a passive information transmission model of student education that has not kept up with the changes in society with this research project challenging an outdated transmission model of education by including the student voice.

Table 1-2 Innovating Pedagogy Report - ten innovations by year

2012	2013	2014	2015	2016	2017
New Pedagogy for e-books	MOOCs	Massive Open Social Learning	Crossover Learning	Learning through Social Media	Spaced Learning
Publisher led Short Courses	Badges to accredit learning	Learning Design informed by Analytics	Learning through Argumentation	Productive Failure	Learners making Science
Assessment for learning	Learning Analytics	Flipped Classroom	Incidental learning	Teach-back	Open Text Books
Badges to accredit learning	Seamless Learning	BYOD	Content-based learning	Design Thinking	Navigating Post-Truth Societies
MOOCs	Crowd Learning	Learning to Learn	Computational Thinking	Learning from the Crowd	Intergroup Empathy
Rebirth of Academic Publishing	Digital Scholarship	Dynamic Assessment	Learning by Doing Science with Remote Labs	Learning through Video Games	Immersive Learning
Seamless learning	Geo-learning	Event-based learning	Embodied learning	Formative analytics	Student led analytics
Learning analytics	Learning from gaming	Learning through storytelling	Adaptive teaching	Learning for the future	Big data inquiry. Thinking with data
Personal inquiry learning	Maker culture	Threshold concepts	Analytics of emotion	Trans-languaging	Learning with internal values
Rhizomatic learning	Citizen inquiry	Bricolage	Stealth assessment	Block-chain for learning	Humanistic knowledge-building communities

1.3.3 **Designing for Digital Learning in Higher Education**

1.3.3.1 Human-Computer Interaction

Human-computer interaction (HCI) provides a theoretical location where the influences of an ever-expanding computing power and availability, the Web and changes in social interaction can be investigated. Consequently, it is important that education understands how these immense technological advances and changes in society can be used by education to enhance learning. An understanding of HCI is relevant to understanding the interactions of learners with educational technology; education must respond to the design and adoption of technology in the same way other areas of society in the Information Age have had to evolve. As Diane Laurillard has pointed out

> "The considerable improvements in human-computer interface design in recent years have brought operational transparency to many types of computer tool. Educational programmes must aspire to the same standard." (Laurillard, 2008, p194)

and involves not only considering how technology can be used in education but how technology can be most effectively integrated into education by applying learning design principles (Conole, 2013). MacKenzie (2013) traces the origins of HCI to work in the 1940s in engineering and the embryonic computer field, though goes on to suggest the Association for Computing Machinery formation of a special interest group on computer-human interaction in 1983 as the disciplines' birth. In 1945 Vannevan Bush theorised how the scientists engaged developing instruments of warfare, should in peacetime devote their expertise to developing tools to access knowledge (Bush, 1945). In the decades that followed the components of what we would recognise today as a computer were invented, though these devices were expensive and located only in a few large organisations (government, universities and businesses) tended by specialist in the new field of computer science. In the early 1980s Stuart Card, Tom Moran and Allen Newell published a book titled "The Psychology of Human–Computer Interaction" laying the theoretical foundations how humans could use computers, with the special interest group (see above) emerging shortly after (MacKenzie, 2013). Research over the following decades investigated the psychological and psychomotor processes of how humans interact with computers drawing from a broad range of academic fields including

psychology, computer science and linguistics. Conole (2013) identified how this range of disciplines brings an equally diverse range of foundational theory and research practice to the discipline and a comprehensive discourse of HCI by Jacko (2012) highlights how the interaction between people and computer technology influences many fields.

When research on human-computer interaction is applied to education a clearer understanding of how learning resources are designed may result, with this current study focussing on understanding how student and tutor designers function in a homogenous group and what pedagogical decisions they make in this process. This may uncover aspects of the design process that facilitates the creation of more efficient and effective learning objects. However, digital technology is still only the tool with which education is delivered in the contemporary climate and as such has forerunners in the use of lectures and tutorials in more established educational models. Therefore, in order to understand the requirements for the effective use of educational technology, it is necessary to refer back to learning theories and how these might apply to digital learning technology.

Higher education in the Information Age draws from the learning theories discussed in section 1.3.1 though nowadays has to accommodate technology. Aparicio, Bacao & Oliveria (2016) discussed how e-learning is a composite of learning and technology though it is important to appreciate terminology and typologies have evolved and reflect what is current at that time. They identified the term e-learning was first associated with computer-assisted instruction in the 1950s though Garrison (2017) suggested the word e-learning became established in the mid-1990s as part of the higher education landscape. However, any application of leaning theory must take into account the context in which it is being used and the same is true for leaning design application. In fact, a constructivist approach is very concerned with the context of learning and it is necessary to take a step back and review some contextual elements within higher education in the UK.

Sharples, McAndrew, Weller et al (2012) explain how education and technology are inextricably linked because of the impact of hardware (e.g. interactive displays in classrooms, personal devices), software and applications that encourage social networking, with the term digital

learning perhaps better describing learning in the Information Age due to the pervasive use of technology in society. Sharples, McAndrew, Weller et al (2013) suggested technological educational innovation in the 1960s commenced with educational television, and in the subsequent decades by language laboratories, computer-based instruction, integrated learning system and virtual worlds in the in the twenty-first century. However, because of the many opportunities technology provides for education to adopt when trying to ascertain what may enhance student learning it is difficult to know what will be worth pursuing.

Gartner's Hype Cycle (Gartner, 2017) eloquently summarised the difficult path educators, academics, institutions have followed when applying technology to education, with Massive Open Online Courses (MOOCs) phenomena illustrating the difficulties. MOOCs have been a recent addition in education, with Pegler (2013) identifying they emerged in 2007 and some courses attracting hundreds of thousands of registrations though many fewer actually completing a course (Daniel, 2012; Kalman, 2014). Sir John Daniel suggests one tangible benefit of MOOCs is that higher education will have to display their teaching approaches and O'Connor (2014) discussed how higher education curricula have been influenced by MOOCs and why investigating the design of educational resources is essential.

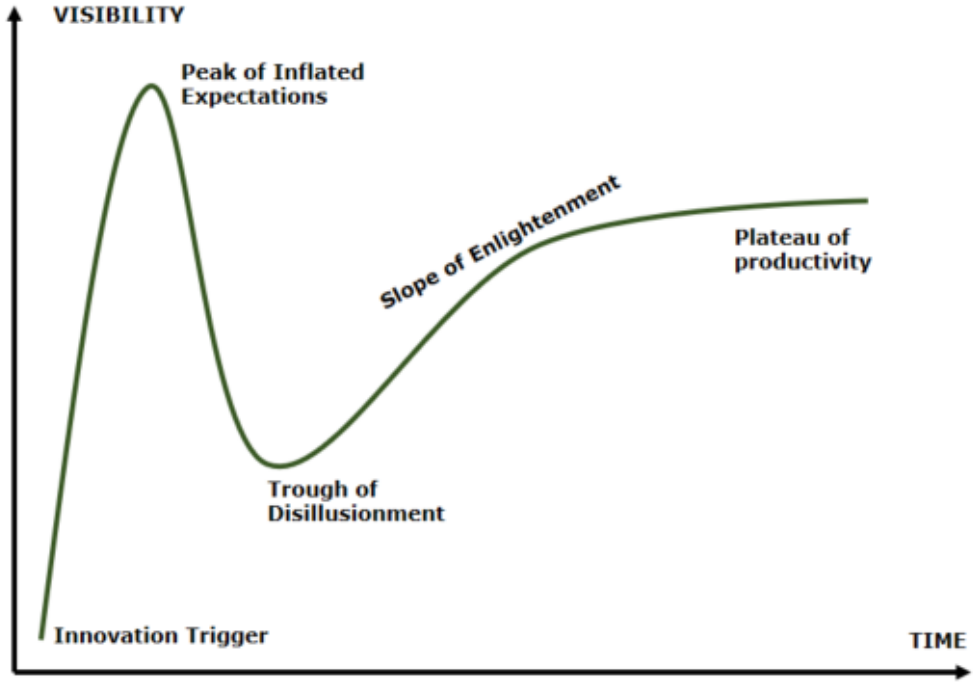


Figure 1-3 Gartner Hype Cycle
Figure 1-3 displays the Gartner Hype Cycle (Gartner, 2017) represents the path taken when new technology is created. The initial enthusiasm sparks an interest that results in a small number of success stories though as failures accumulate a reality emerges a technology may not provide a simple solution. However, as time progresses the use of a technology is better understood and an upward trajectory continues until market opportunities and commercial success arrives, though not at the initial level of expectation.

1.3.3.2 Learning Design

Whether academics who teach students in higher education possess a similar or greater level of technological expertise is debateable. They have experienced the Information Age in parallel with their students and may only have learnt about technology piecemeal as part of their professional and personal life (Rosen & Nelson, 2008) and have not possessed sufficient digital pedagogical knowledge to design effective resources (Conole, 2014).

Pedagogical theory is an essential foundation for the design of effective educational resources with efforts made to understand the pedagogy underpinning the design of digital educational resources. Conole (2013) reported Merrill's principles, Goodyear & Retalis pedagogical patterns based on Alexander's work and a number of organisations supporting pedagogical research across the globe (ALT in the UK, ASCILITE in Australia and AECT in the USA), in addition to the Agile Development Method (Boyle, Cook, Windle et al 2006; Wharrad & Windle, 2010) adopted in this research. Laurillard (2008) suggested it is from tutors engaging with learners that

effective resources are developed and by combining experience (recalling learning a particular concept is challenging), interaction with students (questions after tutorials) and research evidence, the tutor is best able to promote effective learning. This research adds the student voice in the design of educational resources to enhance student learning.

It is important to understand the ways in which digital learning can be designed to meet pedagogical needs with The Larnaca Declaration on Learning Design by Dalziel, Conole, Wills et al (2016) an attempt to draw together research and practice as a foundation for the dissemination of best teaching practice. Just as learning theories have evolved over many decades (see section 1.3.1) so too must learning in the Information Age. The authors of the Larnaca Declaration suggested just as musical notation enabled the dissemination of music, a framework that represents teaching and learning could be used to disseminate educational practice though as Lockyer, Agostinho & Bennett (2016) also discussed, there is no common taxonomy or terminology for researchers and practitioners to refer. However, the kernel of the Larnaca Declaration comprises 1) formal representations of and software to facilitate sharing and re-use of learning designs in an iterative manner, 2) localising and personalising learning and adopting a pedagogical approach for all disciplines and 3) focussing on the learner and how an educator can assist a student with their learning.

As discussed at the start of this section a definition of what e-learning actually consists of is broad and a function of what technology is available at that time. The Information Age has disrupted a traditional teacher-centred didactic approach to education (Galway, Corbett, Takaro et al 2014) though learning design provides a theoretical basis to investigate the design of educational resources in the twenty-first century.

For learning design to influence the education of students, it is necessary to categorise and classify different types of digital learning with Oliver (2007) providing a typology of information communication technologies in higher education (Figure 1-4). This framework demonstrates four areas where educators can facilitate learning including resources used by students, the design of learning, learning activities and an overall model where learning can occur. This research investigated how one type of

learning, namely learning objects are designed and is discussed in the next section.

Activities supporting implementing ICT into university learning and teaching

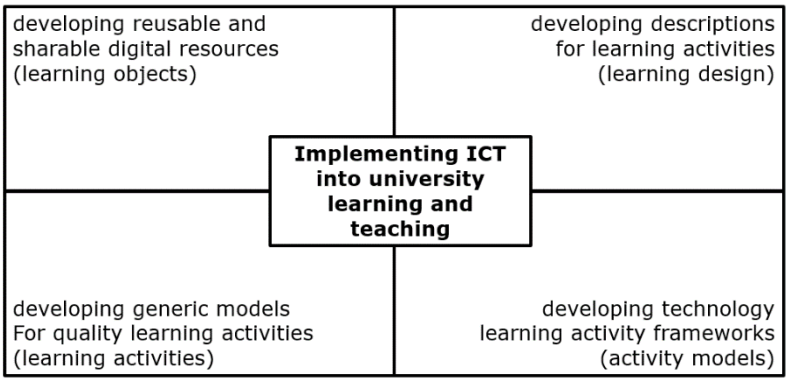


Figure 1-4 Framework of activities supporting ICT.
Figure 1-4 displays a framework of activities supporting the implementation of information communication technologies into university teaching and learning (Oliver, 2007). This research project investigated how learning objects (upper left quadrant) are designed by students and by tutors with the framework demonstrating how learning objects are part of a higher education learning ecosystem and each quadrant integral to the provision of an effective learning environment.

1.3.3.3 Learning Objects

One type of educational resource used by students to access knowledge within or outside formal structures are small multimedia packages of learning, commonly referred to as learning objects that have their genesis in computer and electrical engineering standards. Wiley (2000, p7) moved the discussion from a technical to an educational sphere by reviewing various suggested definitions of learning objects and then settling on "…any digital resource that can be used to support learning." accepting a learning object will be reusable and digital as a result of the technological changes in society (discussed in section 1.2). He went on to provide an initial taxonomy suggesting learning objects can be classified into five distinct types (fundamental, combined-closed, combined-open, generative-presentation and generative-instructional) listing eight characteristics (Wiley, 2000, p24) (see Table 1-3).

Table 1-3 Preliminary taxonomy of Learning Object Types

Characteristic	**Fundamental**	**Combined -closed**	**Combined -open**	**Generative-presentation**	**Generative-instructional**
Number of elements combined	One	Few	Many	Few - Many	Few - Many
Type of objects contained	Single	Single, Combined-closed	All	Single, Combined-closed	Single, Combined-closed, Generative-presentation
Reusable component objects	(Not applicable)	No	Yes	Yes / No	Yes / No
Common function	Exhibit, display	Pre-designed instruction or practice	Pre-designed instruction and / or practice	Exhibit, display	Computer-generated instruction and / or practice
Extra-object dependence	No	No	Yes	Yes / No	Yes
Type of logic contained in object	(Not applicable)	None, or answer sheet-based item scoring	None, or domain-specific instructional and assessment strategies	Domain-specific presentation strategies	Domain-independent Presentation, instructional and assessment strategies
Potential for inter-contextual reuse	High	Medium	Low	High	High
Potential for intra-contextual reuse	Low	Low	Medium	High	High

Boyle (2003) continued this discussion by describing learning objects as either simple consisting of one "independent object" or compound that includes more content and interactivity through the use of media. An important feature of learning objects appears to be that small is better than large, as the larger a learning object is, the less easy it is to reuse or re-purpose (Littlejohn and Peglar, 2007). The term reusable learning object (RLO) has become common parlance in education with the term used when referring to learning objects, though there has been discussion around a

definition what an RLO actually is. By considering each word of an RLO, a clearer understanding of the term is possible (Windle and Wharrad, 2010).

For an RLO to be reusable requires the designer consider technical and content aspects. A resource that is not accessible because it requires proprietary software or devices or is located on a password protected location, will reduce reuse and similarly if the content is less or not recognisable to the user, again reusability is compromised. Copyright restrictions can also hinder reuse though the use of a Creative Commons licence mitigates against this potentially stifling effect (Creative Commons, undated).

Learning requires more than the provision of information by a tutor to a student, with very small resources not achieving a threshold that suggests learning has occurred. Learning is an active process (discussed in section 1.3.1 above) with the user of an RLO engaging with the resource to acquire knowledge that ultimately changes the learner's proficiency in performing a skill, a behaviour or their attitude. For a resource to contain sufficient though not excessive content, pedagogy and not just technology must drive the learning object design, with a peer review process as described by Boyle et al (2006) crucial.

The term object has its origins in object-orientated programming in computing though in relation to RLO refers to the learning resource being self-contained, small and granular. The importance of an RLO being self-contained means the user does not have to rely on other material to support learning and though the optimal size of an learning object is unknown, smaller resources appear to be preferred by learners (Windle & Wharrad, 2010).

The term reusable was implicit in Wiley's definition discussed above, though the size and range of resources that can be referred to as an RLO can be bewildering and even the principle of learning objects have been criticised by Butson (2003) who suggested education has been reduced to a simplistic technical process. Friesen (2003) also criticised a simplistic view of a learning object being "…as small as a drop, as wide as an ocean…" with Windle and Wharrad (2010) suggesting a narrower definition of a learning object - accepting this would exclude very small and large

resources - would provide a clearer picture what a learning resource is. It may be larger resources are actually learning activities or activity models in Oviler's framework (Fig. 1-5), discussed above in Section 1.3.3.2.

The learning objects (or RLOs) designed by the students and by the tutors were most closely aligned to Wiley's combined-open learning object and compound according to Boyle's criteria, as both RLOs included a range of media. However, it is important to note the learning objects on resuscitation created by the students and the tutors were only a vehicle to understand how designers function and what pedagogical decisions each group made when designing an educational resource (phase 1), then used to determine any learning effect and acceptability (phase 2).

1.3.4 The Design of Learning Objects

Learning objects provide a means for learners to acquire established knowledge though how can educators be confident the content is aligned to the learner's needs? Adults learn because of a motivation and readiness to engage with education (Matheson & Matheson, 2015) with this concept integral in a university learning environment (Clapper, 2010) though learning resources designed by tutors in a didactic manner with little theoretical basis are of much less value (Muirhead, 2007). In addition, Gordon, Booth & Bywater (2010) argue pedagogy not technology should provide the impetus to create online resources and this research project was planned to advance the understanding how learning objects are designed for higher education students in the Information Age.

The widespread availability and use of technology and in particular the use of learning objects has created a step change in education. Students experience and use of technology in compulsory education and as part of society means they will expect universities to offer well-designed digital learning resources. In addition, students are encouraged to contribute to their learning in ways that were not possible even a decade ago. Educators and universities charged with providing the highest quality university education should embrace this opportunity to enhance student learning. Part of this process is to establish how learning objects used to acquire established knowledge are designed, as without an understanding of the pedagogical foundations of these resources, progress in learning objects design may not be as rapid.

Learning during the Third Industrial Revolution and earlier revolved around the teacher as the dominant voice in the design of education though in the Fourth Industrial Revolution - the Information Age – students, with the support of tutors can assume a principle role in the design of resources used to acquire established knowledge (Figure 1.5). By enabling the student to assume a principal role in the design process, a learning object may be more aligned to a student's needs, conferring additional learning gains as Keefe & Wharrad (2012) reported in their investigation of nursing students learning about pain management. However to identify why student designed learning objects may confer additional learning gains requires an investigation of the design process with the Agile Development Method (Boyle et al, 2006; Wharrad and Windle, 2010) encouraging the involvement of those who have a stake in the resource.

The Design of Learning Objects to acquire established knowledge

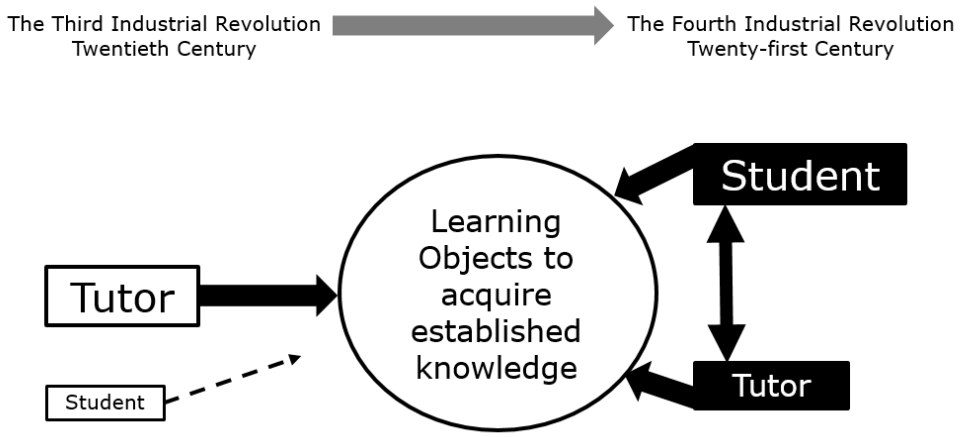


Figure 1-5 Who designs Learning Objects?
Figure 1-5 displays traditional education in the 20th century positions the tutor leading all educational design (i.e. resources, curricula) whereas learning in the Fourth Industrial Revolution in the 21st century Information Age the student with tutors can undertake a principle role in designing learning resources on established knowledge, as long as there is a robust methodology and peer review process to ensure accuracy.

Pedagogical theory should provide the foundations for the design of educational resources though there is no one template to follow. By promoting the role of students and enabling their voice to be heard in the design of educational resources whilst including expert review, the resources may be more aligned to student learning needs and ensure content accuracy as Conole (2008, p136) highlighted that "…well presented work is not necessarily good in terms of content.". The opportunities available to enhance student learning are only constrained by the technology available and by the innovation of tutors investigating how

novel learning methods can be devised and deployed. This study focusses on the design of learning objects as they are well used in nurse education (Blake, 2010) and there is an expertise in creating and facilitating their use (University of Nottingham, undated a). It is therefore necessary to identify a suitable area of established knowledge that can be used to base this investigation of how learning objects are designed. Resuscitation provides an ideal vehicle because the principles of basic life support are internationally agreed and there is evidence that resuscitation knowledge is not learnt well in the nursing and other health professions (see next, section 1.4).

1.4 Resuscitation and Nursing

1.4.1 The History and Importance of Resuscitation

The principles of CPR reviving a person in cardiac arrest has been accepted as a realistic intervention for over five decades. The intervention consists of confirming cardiac arrest, calling for assistance, the provision of chest compressions and mouth-to-mouth ventilation, and when combined with defibrillation can reverse the process of death. Though there are anecdotal reports in previous centuries of efforts to revive a person at death, research in the early 1960s by Kowenhoven, Knickerbocker and Jude (Acosta, Varon, Sternbach & Baskett, 2005) and by Peter Safar (Mitka, 2003) demonstrated the benefit of CPR and defibrillation known as the ABC of resuscitation (Acierno & Worrell, 2007). Resuscitation has evolved into a distinct discipline investigating the theory and practice underpinning interventions, the development and publication of evidence based guidelines and more recently, education for individuals employed in the health community (nurses, doctors, allied health professionals and support staff) and for the lay person. CPR and defibrillation form the cornerstone of resuscitation in the twenty-first century though the discipline has expanded to include advanced life support, pharmacological and surgical interventions, all supported by the global International Liaison Committee on Resuscitation (Resuscitation Council 2015a).

In a healthcare environment, CPR is most likely to be instituted by clinically trained staff when they commence a resuscitation attempt on a person who has collapsed. The actions staff take will be determined by their clinical background, what level of resuscitation education they have received, their

experience and role with-in the organisation. The Chain of Survival (Figure 1-1), popularised by Cummins, Ornato, Thies & Pepe (1991) highlights key resuscitation steps that must be learnt and performed effectively by any person responding to an emergency, if an individual in cardiac arrest is to survive.

1.4.2 Key Concepts of Resuscitation Training

The essential concepts of resuscitation training to be learnt is based on the Chain of Survival (Figure 1-1) describing what knowledge should be acquired depending on their role and education as a health professional.

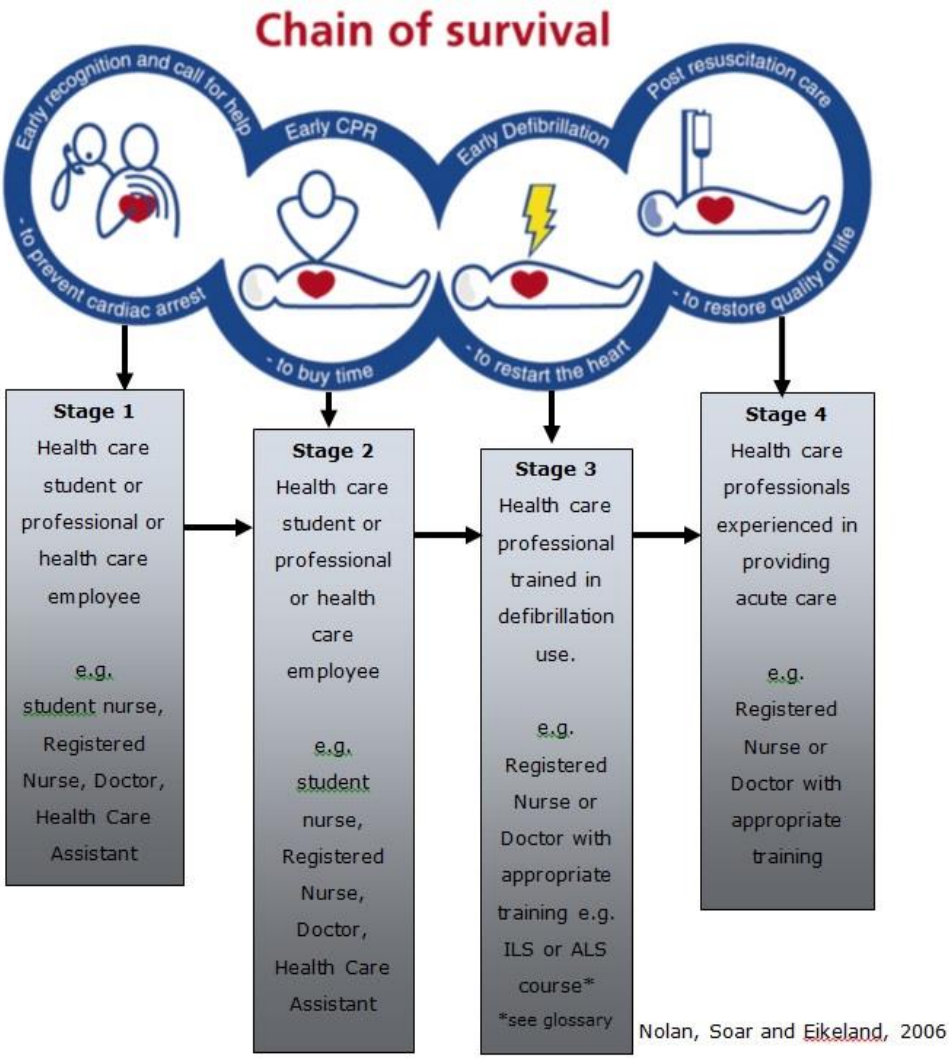


Figure 1-6 Chain of Survival
Figure 1-6 displays the Chain of Survival illustrates the importance of all stages of a resuscitation attempt with annotations below added by this author highlighting at which stage health care professionals, students or trained assistants are likely to be involved.

Stage 1 - Recognising an emergency and calling for assistance.

For staff to identify a person is in cardiac arrest, they need to establish the individual is un-responsive, not breathing and has no effective circulation, before summoning urgent assistance. The process of determining if a collapsed person is in cardiac arrest is crucial as without this assessment, appropriate expedient interventions will not follow.

Stage 2 - Early cardio-pulmonary resuscitation

Cardiopulmonary resuscitation (CPR) is the provision of chest compressions and ventilation to a person who is in cardiac arrest. No matter what your level of experience if you are the only person present and have summoned help, this is your next task. For many staff this will be the most they can do before more experienced staff and equipment arrive with the Resuscitation Guidelines 2015 highlighting the importance of providing effective CPR (Resuscitation Council 2015b).

Stage 3 and 4 - Early defibrillation and post resuscitation care[2]

Defibrillation is the process of applying a controlled electric shock to the person's chest with the intention of reverting abnormal cardiac electrical activity and post resuscitation care describes advanced interventions such as admissions to a critical care unit.

Performing all of these interventions allows the best chance for a person suffering a cardiac arrest recovering and lead a normal life again. However Stage 1 and 2 in the Chain of Survival are crucial as the application of more advanced resuscitation interventions (Stages 3 & 4) are much less likely to benefit to the collapsed person if the initial interventions have not occurred (Resuscitation Council 2015b). And whilst the assessment of a person who has collapsed and chest compressions are psycho-motor skills accepted practice dictates resuscitation training commences with knowledge acquisition before practice on manikins in a simulated environment.

[2] Stage 3 and 4 of the Chain of Survival narrative have been combined as the focus of this thesis is on how knowledge of Stage 1 and 2 is most effectively translated into an RLO for use by nursing students.

1.4.3 **Nurses Responsibility to Resuscitate**

The global awareness of resuscitation guidelines including the assessment of a collapsed person and the provision of CPR are a result of the collaborations co-ordinated by the International Liaison Committee on Resuscitation (ILCOR, 2017). The development of evidence-based guidelines allows resuscitation interventions to be learnt and deployed by health professionals, those with a duty to respond and the public. Whilst there is no specific legal requirement for members of the public to learn CPR, there will be expectations for employees with a duty of care (e.g. police officers, lifeguards) and certainly for health professionals to deliver effective resuscitation interventions, commensurate with their education and role in an organisation.

Registered Nurses must acquire resuscitation knowledge and learn CPR as part of their pre-registration education and they should continue to demonstrate these abilities during their career following accepted national guidelines. If a Registered Nurse is not able to they may be referred to the NMC who will consider whether they have maintained sufficient knowledge and skills required of the profession (NMC, 2014), could be the focus of undesired media attention (Himelfield, 2014) or censured by their employer (Calkin, 2013). According to 'The Code' that guides the profession (NMC 2015b), Registered Nurses should be able to respond adequately in an emergency situation and will be judged by the Professional Conduct Committee of the Nursing and Midwifery Council should they fall far short of what is expected by their peers and society (Table 1-1) and nurses are likely to be the first health professional to respond to an emergency as a survey of hospital staff identified (Buck-Barrett & Squires, 2004).

Table 1-4 Regulatory requirement for Registered Nurses.

	NMC The Code.
Professional requirement Point 15	**Always offer help if an emergency arises in your practice setting or elsewhere** To achieve this, you must: 15.1 only act in an emergency within the limited of your knowledge and competence 15.2 arrange, wherever possible, for emergency care to be accessed and provided promptly, and 15.3 take account of your own safety, the safety of others and the availability of other options for providing care
Knowledge and skill requirement Point 6	**Always practice in line with the best available evidence** **Use the best available evidence.** To achieve this, you must: 6.1 make sure that any information or advice given is evidence based, including information relating to using any healthcare products or services, and 6.2 maintain the knowledge and skills you need for safe and effective practice

Literature demonstrates a range of health professionals do not possess or retain resuscitation knowledge or skill (Curry & Gass, 1987; Devlin, 1999; O'Donnell, 1990; Wynne, Marteau, Johnson et al 1987; Yakel, 1989) with students displaying similar deficiencies (Badger & Rawstorne, 1998; Madden, 2006; Moule & Knight, 1997; Nyman & Sihvonen, 2000) when assessed in a simulated environment. Of even more concern is the inability of health professionals responding to emergencies in clinical practice displaying similar deficiencies (Abella, Alvarado, Myklebust et al, 2005a; Abella, Sandbo, Vassilitos et al 2005b). However the focus on the nursing profession is necessary as they represent the largest staff group in the NHS with over 310,000 Registered Nurses working in the organisation (NHS Confederation, undated). This essential knowledge must be learnt during their pre-registration nursing education and as their career continues only refresher education required (unless additional roles are undertaken).

1.4.4 Nursing Students Resuscitation Training

The current "*Standards for pre-registration nursing education*" specify by the first (of three) progression points of their course, an individual should demonstrate the following:

> "Responds appropriately when faced with an emergency or a sudden deterioration in a person's physical or psychological condition (for example, abnormal vital signs, collapse, cardiac arrest, self-harm, extremely challenging behaviour, attempted suicide) including seeking help from an appropriate person."
> (NMC, 2010, p113)

The content of pre-registration nursing curricula in the UK is not specified leaving how particular subjects are taught for each university to decide, though it is inconceivable a course would be approved without the inclusion of appropriate resuscitation education.

Pre-registration nursing resuscitation education is invariably undertaken in a simulated environment using task based manikins (Maran & Glavin, 2003) though prior to this there should be a knowledge acquisition process (e.g. a lecture or guided study package). The tutor may be a specialist in resuscitation education or have more general teaching abilities and an interest in the subject, though there is no requirement for those teaching pre-registration nursing students' resuscitation to hold formal resuscitation instructor qualifications. Academic teaching staff are encouraged to gain a teaching qualification and if they are a Registered Nurse, the NMC Registered Teacher award, though these are not resuscitation specific awards.

By allowing each university to determine how resuscitation training is provided for nursing students, a variety of educational approaches to achieve curriculum outcomes are possible. The phrase 'the chain is only as strong as it weakest link' often referred to when teaching resuscitation emphasises the importance of all stages of a resuscitation attempt (see Section 1.2.2.). As resuscitation guidelines highlight the prominence of identifying cardiac arrest and early CPR (Resuscitation Council 2015b) it is essential individuals with a duty to respond have learnt resuscitation knowledge to deliver interventions in clinical practice.

1.4.5 Why is Resuscitation Knowledge not Acquired?

Deficiencies in the ability of nurses, doctors and other health staff to perform essential resuscitation interventions in a simulated environment have been established by a number of authors over decades (see Section 1.2.3). Initially investigations were focussed on qualified medical and nursing staff though the assessment of nursing students' ability to perform cardio-pulmonary resuscitation has been reported (see Section 1.2.4). Latterly there has been investigation into the abilities of others working in the health sector (Castle, Garton & Kenward, 2007; Mellor & Woollard, 2010) where health care assistants also participated in their research and Josipovic, Webb & McGrath (2009) survey of nursing and chiropractic

students demonstrated deficiencies in their resuscitation knowledge. The literature indicates other registered practitioners and health professional students are not able to provide effective resuscitation interventions and this work may influence all pre-registration health professional curricula. However the focus of this work remains with nursing students as to extend the study would create difficulties comparing multiple professional groups and because nurses are one of the most likely staff groups to respond to hospital emergencies.

Reasons for sub-optimal resuscitation knowledge and performance of CPR by Registered Nurses could be due to inadequate refresher education, though as nursing students also perform poorly when assessed in a simulated environment, it appears the initial acquisition of this knowledge and skill is where the deficiencies lie (Kaye, Rallis, Mancini et al 1991). There is no prescribed educational approach for nursing students to learn resuscitation knowledge as they may access lectures, small group work, seminars, practical skill stations, peer instruction, online learning and technology driven interventions that will be discussed in Chapter Two. It may be a number of methods are used and though some interventions (e.g. peer instruction, online learning) show promise, the most effective approach remains unknown. By investigating the design of online learning resources it is possible features that enhance knowledge acquisition may be identified.

Organisations such as the Resuscitation Council (UK), the St John's Ambulance Brigade and the British Heart Foundation produce resources on various media (online and DVD) though it is the individual teacher, group of teachers or university who decide what and how educational material is used. The use of YouTube™ as a source of clinical skills educational material has been investigated by Duncan, Yarwood-Ross & Haigh (2013) and CPR was identified as one of the ten most relevant topics to junior nursing students. None of the videos rated were "good", six as "satisfactory" and four as "unsatisfactory" or "poor". If resources are more aligned to the learners' needs it is possible the student can acquire established resuscitation knowledge more effectively, allowing time to be devoted to the mastery of practical resuscitation skills.

It is reasonable to assume those involved in teaching resuscitation will have an interest in the subject though tutors may possess varying degrees of resuscitation ability, perhaps having specialised during their clinical career in areas where acute clinical emergencies are much less common (e.g. community nursing, palliative care). And if a nurse tutor did not acquire a sound grasp of resuscitation in their pre-registration education, it is not surprising they may be less effective when teaching the subject to others with Kaye et al (1991) suggesting it is neither the learner nor the curriculum, but the instructor who is at fault and why resuscitation is not initially learnt well.

1.4.6 Implications for Clinical Practice.

The identification of sub-optimal resuscitation practice by nurses and doctors in a simulated environment should be sufficiently worrying to prompt action by educators. Abella et al, (2005a) study of resuscitation teams' abilities demonstrating these deficiencies are evident in clinical practice means investigation into how resuscitation knowledge is learnt is essential. In an observational study they report well trained teams were not able to consistently and effectively deliver chest compressions and ventilation in the clinical environment. Albella and colleagues designed a 16 month prospective observational study enrolling sixty-seven patients who suffered an in-hospital cardiac arrest. They assessed the first five minutes of the event recording the rate and depth of chest compressions using adapted defibrillation pads. They reasonably postulate the data acquired at the start of a resuscitation attempt represented the best efforts of the responding team with all participating nurses and doctors possessing formal certified basic or advanced life support education as required by the hospital. The investigation found chest compression rates were less than 90/minute in 41% and over 110/minute in 37% of the 67 cardiac arrest events observed, when the guidelines at the time recommended rate of 100/minute. Similar variations were identified in ventilation rates though there were no statistically significant differences in the key parameters measured between the group who achieve a return of spontaneous circulation (ROSC) and those who did not. However the deviation from published guidelines is concerning as staff are not implementing evidence based guidelines.

Abella and colleagues also investigated a team's resuscitation abilities with trained observers unobtrusively attending cardiac arrest calls, using modified personal digital assistant to record when chest compressions were delivered (Abella et al, 2005b). The study occurred over three hospitals and 97 cardiac arrest events providing 813 minutes of data. The ethical approval for the study meant the only outcome measure recorded was if the patient had a ROSC for five minutes post cardiac arrest, limiting any further analysis age or co-morbidity played in the outcome. The chest compressions were analysed in 30 second segments and demonstrated a range of mean chest compression rates at variance from the current recommendations. There was a statistically significant difference in chest compression rate per minute between those who did achieve a ROSC and those who did not (90±17/minute versus 79±18/minute, $p=0.003$), leading the authors to suggest the improved survival rate could be a function of better chest compression or alternatively the futility of the resuscitation was already apparent to the resuscitation team and their efforts mirrored their perception of the likely outcome.

A decade earlier in a small scale investigation of nurses' recollection of clinical cardiac arrest events by Page & Meerabeau (1996), participants reported their resuscitation education had not prepared them well for the reality of an actual cardiac arrest. The authors also postulated a nurse's prior engagement with learning and the presumed likelihood of death once a person suffers a cardiac arrest could influence the actual performance of CPR and described this as "professional apathy". As CPR is an accepted clinical procedure, sub-optimal performance on the basis of perceived futility risks regulatory and even legal action against an individual.

Due to the complexity and ethical challenges of performing human studies investigating resuscitation, much research is based on animal studies complemented by observational cohort studies in a simulated (or less frequently clinical) environment. This does limit the ability to confirm what interventions show most promise however the work by Abella and colleagues suggests nurses and doctors do not consistently follow established international guidelines when performing resuscitation in a clinical environment.

If nurses and resuscitation teams with formal certificated resuscitation education are not able to provide effective CPR, then this deficit appears at least in part to be due to education and new approaches are required to bridge this gap. One possible route to achieve this is through the use of technology in education.

1.5 Summary

The changes in universities brought about by the impact of technology (section 1.2), the way our understanding of learning has evolved in the Information Age with the rapid adoption of technology by learners (section 1.3) has raised the profile of learning design. However actually defining how learning in the twenty-first century can be achieved can be elusive because of the rapid evolution in technology; just remembering what devices and software were commonplace at the dawn of the twenty-first century illustrates the exponential progress achieved in a very short time. Younger learners in the Information Age have used technology throughout their life in school and as part of society with perhaps a decade or more experience of the Web. Older learners who commence or continue education have experienced the same societal changes albeit at a later stage in their life, and inexorably leads us to the position the student population in the Information Age are learning in very different ways to that experienced by most of their tutors. Students in the UK will continue to embrace technology to access learning and there is no reason to suppose other countries with similar higher education systems are not also undergoing these changes.

Moreover, because of drivers discussed by Goodyear (2015) influencing higher education (section 1.3.2), students will not tolerate sub-standard tuition and will make their views known through influential surveys such as the National Student Survey that contributes to university league tables in the United Kingdom (Currens, 2011; HEFCE 2015). Where these forces combine with a Student Union's views and discussion on social media about teaching methods in a negative fashion, universities must act to address deficiencies identified. Kennedy, Krause, Gray et al, (2006) and Conole, de Laat, Dillon & Darby (2008) identified there is a gap between student expectation and what universities provide and though there was positive comment about the use of technology, difficulties remain. The lack of the learner view has been identified in further and higher education (Sharpe, et

al 2005) and in the compulsory education sector (Kerawalla, Littleton, Scanlon et al 2013) as the teacher voice dominated the design of education activities. In particular, the presentation and navigation of e-learning resources was considered inadequate and by paying more attention to the contribution students can make in the design of educational resources, this deficit could be addressed (Bovill, Cook-Sathers & Felten, 2011).

Key questions remain and digital learning pedagogy in many ways is still in its' infancy compared to our understanding of other forms of pedagogy, though work by Helen Beetham, Graninne Conole, Dianne Laurillard, Martin Oliver, Richard Windle and Heather Wharrad (Beetham & Sharpe, 2013: Conole, 2013; Laurillard, 2008/2012; Oliver, 2010; Windle & Wharrad, 2010) among others demonstrates investigating and understanding learning in the Information Age is in progress. This research investigated the design of learning objects by student and by tutors in higher education. It aimed to uncover the pedagogical decisions made by designers, whether there are differences in their decisions and if differences are apparent, whether different designers of learning object enhanced knowledge acquisition. It may be because of societal changes and technology that students are better placed than tutors to assume a primary role in designing learning resources on established knowledge, because the student is closer to their peer and education must embrace the opportunities afforded by technological advances in the Information Age.

Furthermore, the need to respond to technological advances is not a one-time action - educators must investigate how subsequent iterations in technology and the infrastructure supporting the Information Age can enhance learning. Paradoxically the exponential increase in the use of technology in education providing novel learning opportunities may hinder identifying the most effective approach, as this profusion in technology provides too many options; resource designers may not know what most enhances learning and what not worth pursuing, highlighting the importance of this work. Educators need to respond to ever-changing student needs and the technological landscape and the underlying message is unambiguous if universities are to accommodate the demands of society represented by students, academics, employers, regulators, and governments; they will need to design and deploy effective learning resources.

Because a homogenous group (either students or tutors) undertook the design of each resource, it was possible to attribute pedagogical decisions made by each group during the storyboard creation process to those participants. This research then measured the learning effect of the student-designed and tutor-designed resources and when these results were analysed with each groups' pedagogical decisions, allowed insight into the learning object design process. Consequently this work will explicate how students and separately tutors design educational resources, whether an RLO designed by students may be more aligned to learners' needs and establish the effectiveness and acceptability of these types of learning resource. Novice students may benefit from an educational resource more aligned to their needs, because a student designer is closer to the learner. In Vygotsky's lexicon, there is less of a gap between the learner and the teacher.

2 Literature Review

This literature review is divided into two sections with the first identifying and discussing literature reporting student designed educational resources with a focus on learning objects, but also including website development, video, podcasts and non-digital student designed resources. The second section reviews literature discussing approaches that investigate how nursing students acquire resuscitation knowledge. The range of databases accessed for each literature search is listed with additional grey literature identified by checking referencing lists and personal communication and the results reported following the PRISMA guidelines (PRISMA, 2015). Two distinct literature reviews were undertaken with the first to identify literature investigating the contribution students can make in the design of education and then to understand research investigating nursing student resuscitation training.

2.1 Student Designed Learning Objects

The use of learning objects in higher education is driven by academics and learning technologists in the sector. The involvement of students in this process has been much less obvious with most of the literature reporting projects evaluating resources created. With the exception of studies already discussed (Brooman et al 2015; Keefe & Wharrad, 2012; University of Nottingham, 2010a; Woolmer et al 2016) there appear few examples of student involvement in the design of self-contained learning objects, hence the need to include other resources in addition to learning objects for the literature in this section. The focus of the search was on students designing resources other learners could use rather than using the design process as a way for students to learn about a subject.

2.1.1 Search strategy

Six academic databases were used to search for literature from 2000 onwards, discussing student designed and developed learning objects, with four specialising in healthcare (CINAHL, EMBASE, Medline and SCOPUS[3]) and two from education (ERIC and Education Abstracts through EBSCO). These healthcare databases are established and well recognised in the

[3] The database provider (OVID) allowed EMBASE and Medline to be searched as one entity.

nursing, medicine and health disciplines, with the final two adding an educational slant allowing a comprehensive search for literature on student designed or developed educational resources in health and non-healthcare disciplines. The search for literature investigating student involvement in this process required the careful use of common terms in education with the word 'student' not included due to the very high number of results returned. The use of the relevant database truncation key to capture derivatives such as "develop*" identifying develops, developed and developing, (see Table 2-2) returned manageable results described in Figure 2-2.

Table 2-1 Student designed RLO search terms

design* AND
develop* AND
reusable OR re-usable AND
learn* AND
object

Literature was excluded on the basis of the title or abstract alone with the term reusable identifying papers discussing infection control, battery use and space technology not relevant to this work. Two other major themes excluded were papers discussing very technical aspects of computer language(s) used and discussions about the evaluation and use of learning objects such as a peer review project reported by Gehringer, Ehresman, Conger and Wagle (2007). Reports of service-user involvement in the design and development of resources for educating health professionals by Fenton (2014) and Beadle, Needham & Dearing (2012) were excluded as the focus of this thesis is to investigate what contribution students can make when designing educational resources (though there may be useful lessons from this work for those working with service users).

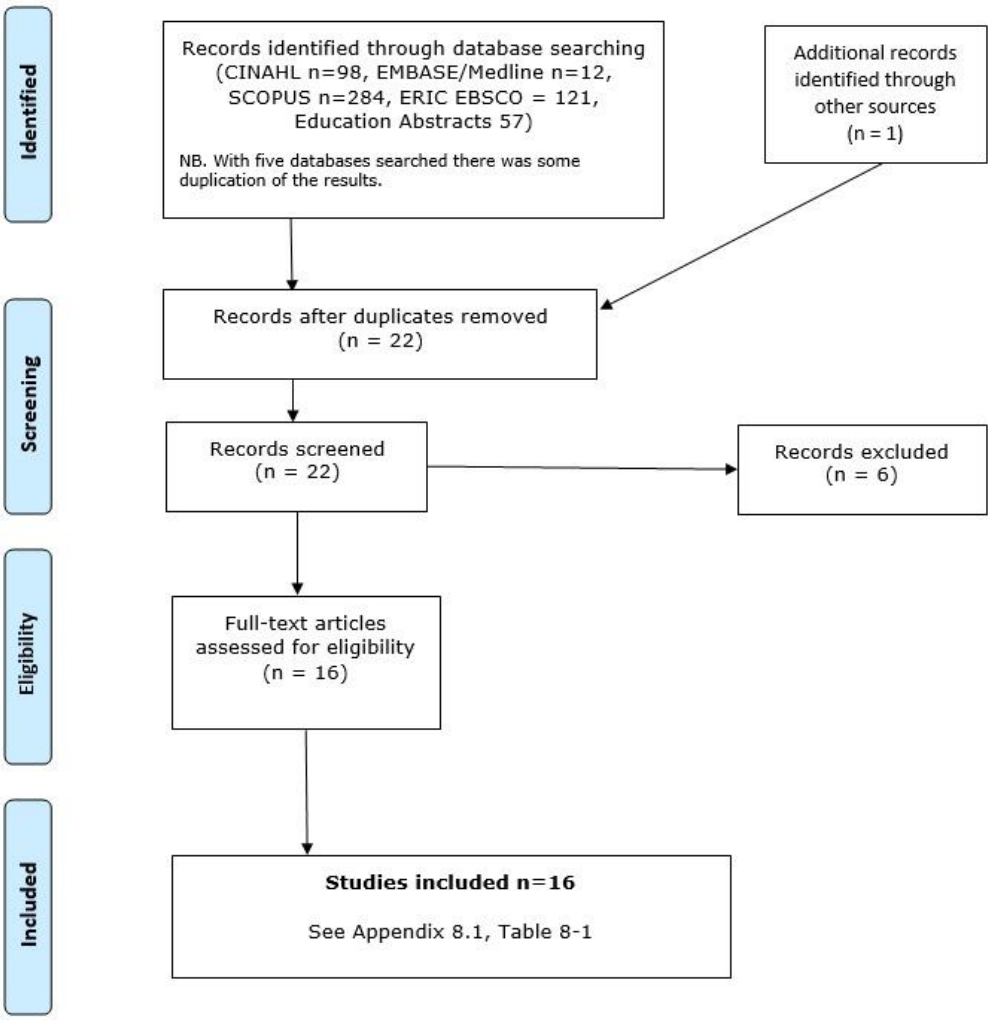


Figure 2-1 Student design learning object search
Based on Moher, D., Liberati, A., Tetzlaff J. & Altman, D. (2009) *P*referred *R*eporting *I*tems for *S*ystematic *R*eviews and *M*eta-*A*nalysis: The PRISMA Statement PLoS Med6(7): e1000097. Doi:101371/journal.pmed1000097

2.1.2 **Student Designed Learning Objects and Resources**

Sixteen papers were included in this review with process of identifying and screening literature illustrated in Figure 2-1. In addition to literature investigating RLOs as defined by Wiley (2000) and Boyle (2003), papers that reported student designed websites, pod and video casting, ubiquitous computing and student designed non-digital learning resources, were included, with a full list of the 16 papers in the Appendix (Table 8.2). Where investigations included an evaluation of a learning object, a Kirkpatrick's Four Level Evaluation (Kirkpatrick 1996) rating (see Section 3.1.3 and Appendix 8.2) was assigned at either Level 1 (Reaction), Level 2 (Learning), Level 3 (Behaviour) or Level 4 (Organisational Impact). No study evaluated the organisational impact or behaviour and only Keefe & Wharrad (2012) evaluating Learning. Nine studies established participant Reaction (Anderson & Wark, 2004; Chang, Kennedy & Petrovic, 2008; Furmedge, Iwata & Gill, 2014; Guler & Altun, 2010; Keating, O'Donnell & Starr, 2013; Rosenbaum, Gorrindo, Patel, et al, 2009; Sandlin, Odom, Lindner & Dooley, 2012; Sweet & Ellaway, 2010; Turner, Ellaway & Yewdall, 2004) and two (Morris & Connolly, 2010; Scown, 2010;) did not warrant the assignment of a Kirkpatrick level. The four other papers identified (Abbot, 2010; Harden, 2005; Jesse et al, 2006; Kurilovas, Serikoviene & Vuorikari 2014) were considered opinion and not an evaluation of an intervention, therefore also not ascribed a Kirkpatrick level.

2.1.2.1 Student Designed Learning Objects

Keefe & Wharrad (2012) investigated the learning effect of a student designed pain management RLO among nursing student participants. One resource focussed on assessment and a second on pharmacological interventions with participants randomly allocated to undertake a questionnaire (control, n=164) or view the RLOs and the questionnaire (intervention, n=42). The intervention group achieved a highly significant increased score in the post intervention knowledge assessment using a valid and reliable tool, demonstrating a student designed e-learning package can facilitate knowledge acquisition. Sandlin et al (2012) reported a phenomenological research project investigating the development of RLOs by twenty undergraduate and postgraduate leadership students based in the USA who spent time abroad in Costa Rica as part of their studies. There was very limited detail of the RLO design, development and

the effect they had on the participants and other users, though qualitative comment suggested participants who initially held reservations about people from other countries found an RLO facilitated their learning of other cultures. The focus of the paper was on the effect travel had on participants though the development of RLOs and the shared learning meant students who remained in the USA were also able to gain from this module.

Broadening the definition of a learning object identified a report of 54 dental students' design of health promotion material as they produced leaflets, posters and presentations using widely available commercial software from the Microsoft Office™ suite (Sweet & Ellaway, 2010). This ACETS (Access, Catalogue, Exemplify, Test and Share) Project was funded by the Joint Information Systems Committee X4L programme (JISC, 2005) supported teachers developing reusable resources, though Sweet and Ellaway's insight by asking students to design educational material suggests learners can also make a valuable contribution to their education. However, the lack of quantitative formal evaluation detail of learning beyond sporadic comment in the papers by Sweet & Ellaway (2012) and Sandlin et al, (2012) highlights educational research should include a robust evaluation of the intervention.

The use of video and podcasts has been investigated by Chang et al (2009) and Scown (2010) though with limited detail included these studies provided little robust evidence of the value self-contained learning objects can play in student education. Chang and colleagues reported to conference, four junior medical students' views of making and using student designed case study podcasts as part of a problem-based learning curriculum. Three themes were identified with students a) questioning the move from teacher to student-centred learning, b) determining when a student can assume more responsibility in learning and c) the benefits of peer learning, acknowledging the role students can play in their education. Though the small sample was recruited from a cohort of 319 and some resistance to becoming more active in the learning process was reported by the participants, they did see a role for student led education. The work by Scown (2010) reported business students choosing to develop a podcast or video or complete an assignment as an assessment for an elective module with the resources subsequently made available for peers. Sparse details of

the results were reported and significant methodological deficiencies means this potentially innovative work does not provide evidence supporting student designed resources.

The promotion of student designed learning resources using technology was reported by Morris & Connolly (2010) who described how two post graduate product design students developed ubiquitous reusable learning applications (URLA) for 30 of their peers to use. Mobile technology (smart phones) was used when exploring a design museum to capture information they could then reflect on, though the main aspect was the role ubiquitous computing could play in learning. The only evaluation was anecdotal comment by a tutor though as interviews and surveys that supported the project aims were mentioned in the conclusions, the inclusion of this quantitative data could have provided stronger evidence of the contribution student designed resources can play.

The development of student designed non-digital learning resources was reported by Keating et al (2013) when they created four separate week long electives (referred to as "selectives") for junior medical students to learn about particular specialities they may wish to focus on in their clinical studies. The main focus of this paper was on the paediatric selective, with hospital medicine, emergency medicine and surgery selectives also offered and included workshops, presentations and discussions panels. There was a variable uptake of the selectives with the paediatric option proving most popular though quantitative data was less well explained in the narrative exemplified by statements such as "We found a mean score of 8.6 students out of 10 responded favourably to the statement…" (ibid, p92). With no tables or figures included this study provides little robust evidence supporting the case for student designed RLOs though there are positive statements about the role students can play in leading the design of learning resources. A more robust evaluation of the interventions could support student designed RLOs as route to enhance student learning.

2.1.2.2 Websites and Virtual Learning Environments.

The project by Turner et al (2004) reported undergraduate medical students' development of websites on science and philosophy as part of a special study module and demonstrated with a small amount of support,

participants were able to produce resources that were almost universally agreed to be as good or better than traditional written reports. The authors also identified other benefits including an awareness of copyright, ethical behaviour and web design, with tutor interest in this also stimulated after viewing the students' work. Unfortunately, a link from the paper (http://renux.dmed.ed.ac.uk/) to the results was unavailable on 29 November 2016 and this research could be described as establishing a "proof of concept", though demonstrated students appear able to design and develop web-based educational resources for their peers.

The potential for medical student to be involved in web design can also be seen in Rosenbaum et al (2009) who with peers, technical and academic staff designed a website for the faculty. Their project included an evaluation of the participant reaction and the detailed virtual learning environment (VLE) showed students can design valuable educational resources. Medical students may be "technology savvy" (Furmedge et al 2014, p814) as also seen in Turner and colleagues work though whether students from other disciplines possess the same ability is unknown. It is reasonable to assume some (e.g. computer and web design students) are likely to possess similar technical skills though the focus of my work is on the design process and not technical abilities. Rosenbaum and colleagues acknowledge the limitations in how they evaluated their work though as the VLE is still available (Figure 2-3) suggests students can design valuable resources for their peers to use, even if a learning effect is not reported.

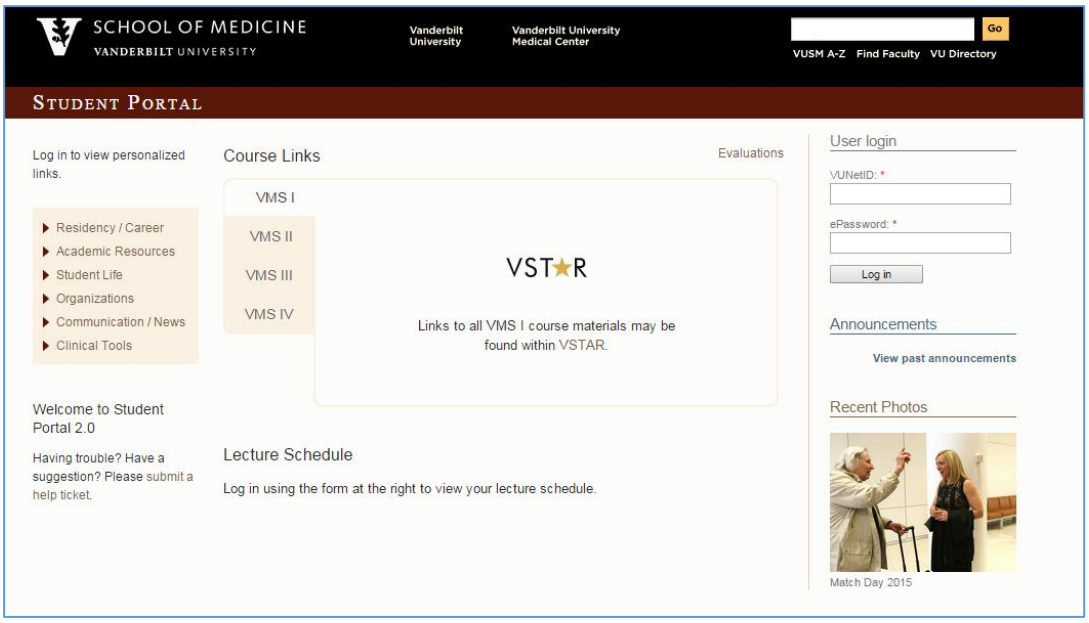


Figure 2-2 Screenshot of web page created by Rosenbaum et al (2009)
Figure 2-5 displays a screen shot accessed in 2015 indicating the website is still available and appears to be in use. Vanderbilt University (2015).

In the United Kingdom, Furmedge et al (2014) report five peer assisted learning projects for medical students with two adopting technology for a case of the month and a video. The cases written by students and academic staff, and then reviewed by academic staff are formatively marked by junior medical practitioners, with all cases well received by students, irrespective of the author. Similarly videos were created "…by students, for students…" (ibid, p814) with minimal supervision and achieved a high degree of acceptance from their peers, though only percentages are reported in the paper with no detail as to the survey sample size. The three other case studies (practical assignment preparation, student views on how mental health should be taught and peer mentoring) whilst not involving technology do identify students led the development and implementation of the intervention. However with no quantifiable data supporting their use and no Kirkpatrick level warranted, it is not possible to draw definitive conclusions.

The potential of student designed content was investigated by Anderson & Wark (2004) project with Masters in Distance Education students though the seventeen participants may have held a heightened interest in novel pedagogical approaches and be atypical of the wider student population. Data was collected through a survey, reflection, individual and group evaluations, a questionnaire and review of insights gained from students and instructors. An ethical approach was adopted as the authors were

cognisant of not disadvantaging students whilst also avoiding any coercive effect from the investigation. Unfortunately the web page (http://survey.icaap.org/html/results.htm) where the detailed results could be reviewed is no longer live when checked on 22 June 2015, though Likert scale data reported in the narrative suggested students found tools (synchronous chat, private email, discussion boards) to engage with their peers and videos and course material contained in the VLE useful. However, aspects requiring more interactivity were less appreciated and as the course students may be completing their studies whilst employed, time pressures could partially account for this finding even though the course was delivered using a distance and therefore more flexible learning model.

The use of RLOs was investigated by Guler & Altun (2010) drawing from a previous paper by Guler, Altun & Askar (2009) where they report how student teachers designed website. The participants described as "prospective teachers" undertook instructional design and software development education in the previous semester, though there is no evidence this additional education conferred any benefit. Given the developments in technology since this study it is possible technical support and advice, as suggested by Furmedge and colleagues may provide sufficient support instead of prospective RLO designers (students or otherwise) undertaking formal instruction. The verbatim results of the interviews highlighted difficulties and uncertainty from the participants, in sharp contrast to the other literature discussed in this section and it may be there are other factors (e.g. the discipline, educational culture where the study was undertaken, accessibility to technology) in RLO design that influenced the findings.

2.1.2.3 Published Opinions on RLOs and e-learning

The potential for technology to facilitate a virtual medical school was discussed by Harden (2005) who reported how this concept comprising many facets of e-learning (RLOs, self-assessments, 'ask-the-expert' and peer learning) could provide continuing medical education, though it was perhaps ahead of its time (Lafferty, 2013). Compared to now, the technology available at the very start of the twenty-first century to develop digital resources required specific skills not widely available and institutions were unsure whether to be involved, apart from being afraid to miss out should the concept succeed. IVIMEDS has now evolved into an academic

partnership, with Lafferty (2013) suggesting MOOCs and other types of educational resource designed using a host of more accessible technology (e.g. Articulate™, YouTube™, social media tools) may reveal opportunities for designers to exploit in the Information Age**.** With the openings possible because of technology, it is important to investigate whether resources designed by students confer additional learning because they may be more aligned to the learners' need.

Concern about pedagogical quality are pertinent with Abbot (2010) suggesting there are risks in promoting unfettered access to user designed resources where the content has little quality control measures applied. However a collaborative approach where students play a significant role in the design following a comprehensive Agile Development Method (Boyle et al, 2006; Wharrad and Windle, 2010) including peer review and evaluation should minimises harm whilst maximising gains, as resources may be more aligned to student learning needs. Kurilovas et al (2014) suggest the learner is integral in the process discussing how users "tag" resources developed creating a rich data set. This information can be analysed to understand how resources are used, though they do not propose a particular design methodology. As part of the process designers may achieve additional learning, though this investigation focussed on the pedagogical decisions student-designers and separately tutor-designers made in the design of an learning object and whether this affected the learning of novice nursing students who accessed one of these resources.

Literature reporting student designed RLOs that meet Wiley's definition of a learning object (Wiley, 2000) demonstrated students can design resources. What is much less known is whether student designed RLOs may facilitate more effective and efficient knowledge acquisition. This investigation will attempt to answer this question and identify whether student designed RLO result in additional learning when compared with tutor designed resources.

2.2 Nursing Student Resuscitation Training.

This section of the review discusses literature reporting methods used to educate nursing students about resuscitation. The focus is on acquiring resuscitation knowledge though inevitably the acquisition of skills permeate discussions. Individual approaches have been influenced by what educational theory and technology is available at the time though there

appears no involvement of nursing students in the design of resuscitation education resources, highlighting this as an area to explore.

There is a discernible trend in resuscitation training in pre-registration nurse education over the period for which the review has taken place towards small group teaching, practical sessions, peer education, self-directed learning and the incorporation of technology and simulation into curricula. The wider availability of technology since the 1990s (e.g. CD-ROM) facilitated a step change in how students access educational resources, further accelerated by evolving technology and the Internet. In parallel and partially a result of advances in technology, simulation has attracted interest and has been investigated as a method of learning resuscitation.

It is not definitively known how resuscitation skills are most effectively learnt though performing practical skills in a clinical environment as a learning episode is ethically controversial (Morag, DeSouza, Steen et al, 2005) and of questionable educational value. The education would be unplanned and haphazard though the role of reflection after a clinical event is a different and worthwhile process. However before practical interventions such as the assessment of a collapsed person or chest compressions can be practised on a manikin in an educational environment, the knowledge underpinning this skill must be acquired.

Self-directed and peer led education are challenging established teaching methods where the tutor acts as a font of knowledge, though novel educational approaches will require careful and robust evaluation. Putting the student in control of their education within established boundaries shows promise though embedding novel methods into a curriculum may require a different use of resources and a change in culture from accepted teaching practice. Marc Prensky describes how students have changed and the education system is not designed for the current student (Prensky 2001; 2007). With students considered more as active partners than passive recipients of education, despite comment by Anderson & Wark (2004) and Chang et al (2008) and becoming more vocal about how and where they learn, tutors and universities must adapt to the demands and embrace change. If not, they will surely fall behind their competitors who do investigate and deploy innovative educational methodologies to enhance

student learning. The involvement of nursing students in the design of an RLO to learn established resuscitation knowledge for their peers could result in a resource more aligned to the learners' needs, facilitating more effective knowledge acquisition.

2.2.1 **Search Strategy**

The search for literature discussing how nursing students learn resuscitation knowledge commenced by identifying relevant databases and determining key words to be employed in the search. Five databases were used to identify literature for this review; CINAHL EBSCO, Medline, EMBASE, SCOPUS and Web of Science with the results of the search summarised in Figure 2-3. The CINAHL EBSCO database returned the highest number of results followed by Medline, World of Science, SCOPUS and EMBASE with the majority of papers accessible using established University systems. A sifting process by reviewing the title and abstract was used to identify relevant literature.

Key words selected to search for literature included "BLS OR basic life support OR cardio* OR resus* AND nurs* AND student*" including Boolean operators and the relevant truncation command for each database to include derivatives of the principle word (Table 2-1). Literature since 1990 was included to ensure a range of approaches were included though some items identified, such as Masters or Doctoral thesis were not accessible despite the assistance of University library staff. Irrelevant literature such as articles for the British Lymphology Society due to the abbreviation "BLS" were identified and discarded.

Table 2-2 Nursing student and resuscitation search terms

BLS OR basic life support or cardio* OR resus* AND
nurs* AND
student*

Four databases allowed the search results to be saved in a spreadsheet format however the CINAHL EBSCO database emailed a link to the results that were manually entered into a spreadsheet. This allowed the results to be managed in a consistent manner providing a clear audit trail to identify which literature would be included in the review. There is the possibility of transcription errors, however given the manually collated results from CINAHL appeared in similar proportion with the literature identified in the

other four automatically downloaded databases, there can be a high degree of confidence in the approach.

The results from each database were reviewed by title and abstract to identify their relevance and a condensed list comprising 134 articles identified and after the removal of duplicates, 74 papers were retained for closer inspection. Of these, 20 articles discussed nursing students resuscitation education approaches in the discussion and were included in this literature review (Figure 2-1 & Appendix 8.1).

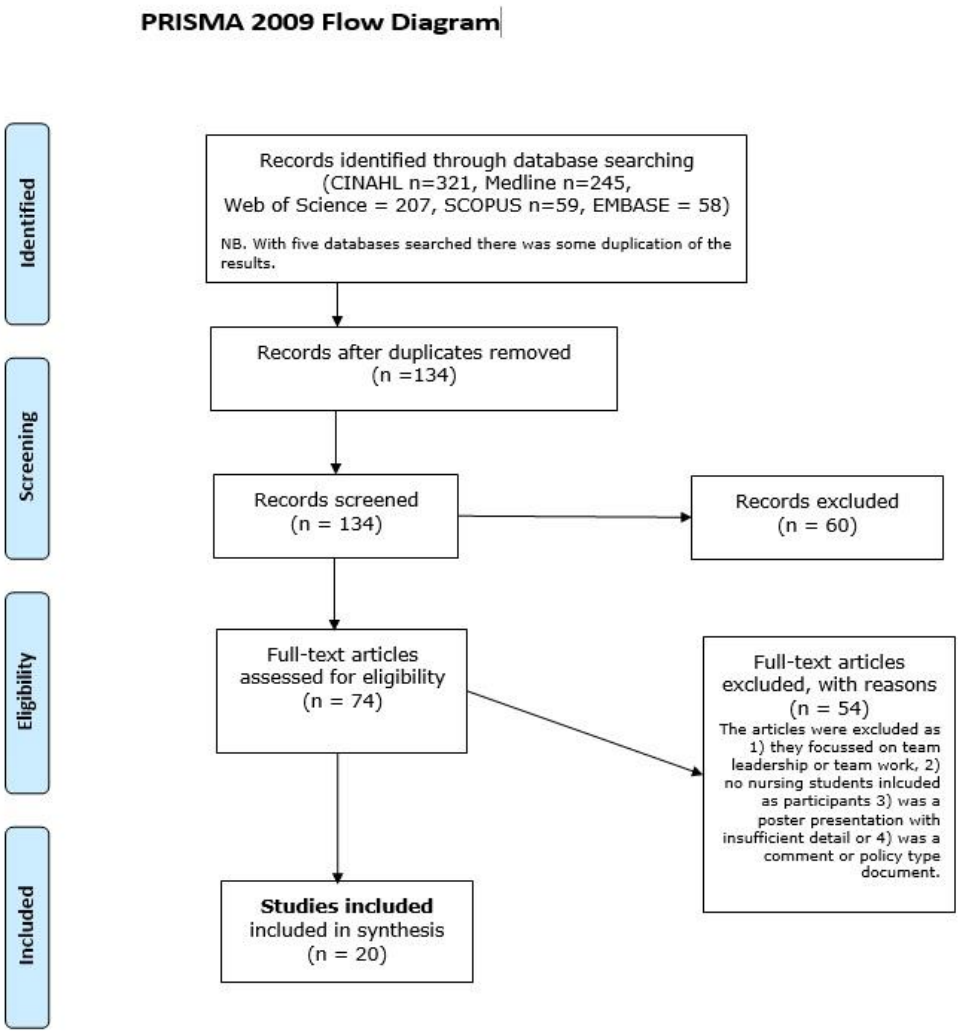


Figure 2-3 Nursing student resuscitation education search
Based on Moher, D., Liberati, A., Tetzlaff J. & Altman, D. (2009) *P*referred *R*eporting *I*tems for *S*ystematic *R*eviews and *M*eta-*A*nalysis: The PRISMA Statement PLoS Med6(7): e1000097. Doi:101371/journal.pmed1000097

2.2.2 **Nursing Student Resuscitation Training Approaches**

The search for nursing student resuscitation training literature identified papers investigating approaches to learning resuscitation, with five distinct themes discussed below. These themes partially reflect the technology available at that time (e.g. the use of CD-ROMs, simulation) though other approaches such as peer education projects are 'technology neutral' focussing on the pedagogical intervention. This review demonstrates a plethora of educational approaches have been investigated though does not definitively suggest a specific intervention is more effective and explains why this study is necessary.

2.2.2.1 CD-ROM

The development of a structured resuscitation education programme for nursing students in the south-west of England was reported by Moule, Gilbert & Chalk (2001) in their description of the Interactive Teaching and Learning (INTaL) project and was subsequently evaluated by Moule (2002). Previous work by Moule & Knight (1997) with an acknowledged small sample suggested the resuscitation training nursing students received was sub-optimal. To address these deficiencies a team of academic representatives from all healthcare disciplines in the college met to develop and implement a plan addressing the concerns.

The INTaL project by Moule, Gilbert & Chalk (2001) brought together five Universities to develop an educational resource based on European Resuscitation Council guidelines accessible on an interactive CD ROM. By using a CD-ROM standardised material could be circulated and easily updated to the institutions involved. Moule and colleagues note the initial development of the CD-ROM was costly though subsequent iterations should be less resource intensive and the ability to revise material is vital if a learning resource is to remain relevant. By delivering resuscitation knowledge in a standardised format following current practice reduces the influence of the instructor on the training provided, particularly if they are an inexperienced teacher in the discipline. Subsequent evaluation of the education by Moule & Gilchrist (2001) ascertained the opinions of twenty-six students who used a CD-ROM to acquire resuscitation knowledge reporting an acceptance of the approach, with the authors also noting a lack of research into the efficacy of novel educational methods.

Moule (2002) formally evaluated the INTaL project by assessing participant resuscitation knowledge pre and post viewing the CD–ROM, how this knowledge acquisition influenced the delivery of ventilation and chest compressions on a manikin and ascertained from a focus group their views on the use of multi-media to deliver education. Three hundred and fifty eight participants were involved in the knowledge assessment with an increase in overall learning noted though not all aspects of the knowledge gains achieved statistical significance. Eighty-eight students completed the skills testing though this did not demonstrate any significant difference or correlation between knowledge and skill performance. The focus group discussions (n=26) reported positive comment in favour of CD-ROM learning though participants confirmed the need for a blended learning approach where teachers contribute to the knowledge acquisition. Technical issues can present a challenge to users and support required to mitigate these issues must be considered in technology driven education.

Monsieurs, Vogels, Bossaert et al (2004) reported the results of a European research project comparing junior nursing students participants with no training (control, n=21) and those who used a CD-ROM (experimental, n=20) to learn resuscitation, where neither group possessed any previous experience. A scenario based assessment using the validated Cardiff Test (Whitfield, Newcombe & Woollard, 2003) of the participant's abilities to assist a person (a manikin) who had collapsed after complaining of chest pain was used. After participants were randomised and those with previous resuscitation education excluded from analysis, there was a statistically significant difference favouring the experimental group in the interventions required to assess a collapsed person, (opening their airway and instituting key CPR techniques). The experimental group also held a positive attitude toward assisting in this type of situation and towards this method of education. The research suggests CD-ROM based education can enhance learning of knowledge and some psychomotor skills though we do not know if an intervention more aligned to the student needs may provide more effective acquisition of established knowledge. With the exponential development of technology and screen based devices, benefits from using CD-ROMs that may be perceived as 'old technology' may be seen in ubiquitous web-based and mobile devices now available.

2.2.2.2 Simulation

Quasi-experimental research by Ackermann (2009) investigated knowledge and skill acquisition by junior nursing students with an experimental group undertaking a simulation scenario. A pre-registration nursing course entry requirement in the USA is that all students possess a current American Heart Association (AHA) Basic Life Support certificate and so this research investigates refresher not initial resuscitation education. The research initially recruited 65 participants though as the power calculation indicated 68 participants in total were required and only 49 returned for follow up three months later, the study was underpowered. There were no differences in pre-intervention knowledge between the control and the experimental group or between students on a four year undergraduate programme and those who already possessed a degree undertaking an accelerated programme. The experimental group achieved significant or highly significant post intervention knowledge and skill acquisition and retention scores. When subsequently tested three months later, though the difference was still apparent both groups achieved lower scores. Ackermann (2009) employed standard AHA tools to determine the participants' knowledge and skill performance demonstrating a statistically significant increase in the acquisition and retention of knowledge and skills with the experimental group. No significant difference was identified between students undertaking the standard four year and those on an accelerated programme, though students who had prior clinical resuscitation experience performed significantly better than those with no exposure to clinical emergencies.

Given the relative lack of research in the nursing students resuscitation abilities compared to investigations with medical students, this work provides a useful contribution to the body of knowledge in this area. With the decay in resuscitation knowledge and skill that has been reported after training perhaps it is more important to establish what interventions enable the learner to most effectively acquire resuscitation knowledge. This investigation may identify how RLOs are designed and what aspects enhance learning from their use, possibly reducing the need for extensive refresher resuscitation training.

Bruce, Scherer, Curran et al (2009) investigated the effect of simulation on the learning of graduate nurses (nurses anaesthetists and critical care nurses, n=11). They included undergraduate nurses (n=107) in a small team lead by the graduate nurse participants though the focus of the research was on the team leader role. The undergraduates' knowledge of resuscitation was tested pre simulation, immediately post simulation and then on a second occasion four to eight weeks later, with knowledge scores remaining constant or increasing for all but two questions, though a lack of detail precludes further consideration of the results. Again the participants were senior undergraduate students who would have undertaken some form of resuscitation education on entry or as part of their studies and therefore not initial resuscitation knowledge acquisition. With no control group it is not possible to discern the effect on their learning compared to standard educational methods though the participants' evaluation did illustrate simulation education was well received. However, insufficient detail was provided to comment on these claims. The undergraduates evaluated their participation in the project positively and being more disposed to this form of learning may influence their motivation to acquired resuscitation knowledge in the future though with no clear quantitative measure of learning it is not possible to draw definitive conclusions about the effect this simulation study had. What does appear clear is students appreciate the deployment of novel educational approaches though evidence of learning is appears somewhat limited.

2.2.2.3 Self-instruction, Small Group and Problem Based Learning

Greig, Elliott, Parboteeah & Wilks (1996) reported a three year study investigating whether the sub-optimal performance of nursing students was a result of their resuscitation knowledge and skills deteriorating or not being learnt in the initial education. The research included a control group of 60 students taught in groups of 15-20 and an experimental group of 12 students in two groups of six. The experimental group size was chosen based on previously published recommendations by Marsden (1989) used today by the Resuscitation Council (UK), who accredit a range of resuscitation courses for those working in the health care sector (Resuscitation Council, 2018). Though the findings favoured the experimental group, with descriptive and not inferential statistics reported

no firm conclusions can be drawn and indicate why close attention to the design and methodology of research investigating education is essential.

Another method of delivering resuscitation education was described by Davies & Gould (2000) who reported students undertaking self-instruction by accessing printed material on resuscitation guidelines and practice on manikins, prior to being assessed on their practical resuscitation abilities. The research design randomly allocated twenty matched senior adult nursing students to one of three groups (Control group A=pre-test & post-test; Control group B=training & post-test; Experimental group=pre-test, training & post-test) described as a "modified three group version of Solomon's four group method" (ibid., p403). This approach isolated the effect of the training as the pre-test scores of the experimental and control group A and the experimental and control group B were not significantly different. This approach is perhaps better described as refresher rather than initial resuscitation education because the students previously received resuscitation education as part of their studies with exposure to clinical emergencies in practice also noted in the matching process.

A different form of what could be considered self-directed learning is problem-based learning (PBL). Fry, Ketteridge & Marshall (2009) highlight the importance of the student in PBL, though there is little strong evidence of its application in teaching resuscitation to nursing students. Szogedi, Zrinyi, Betlehem et al (2010) report a retrospective review of final marks awarded for resuscitation component of the curriculum, comparing PBL with traditional resuscitation instruction in nursing students over a seven year period. Whilst the authors claim PBL provided more effective learning, there are major limitations in the research that make it difficult to accept this view. Traditional methods comprised a large group (n=25) receiving didactic teaching with little or no feedback, whereas the PBL groups were smaller (n<10) and involved the students in the learning as self, peer and formative feedback was provided. Additionally there appeared to be no consideration of previous knowledge or ability and the authors acknowledge possible confounding variables (different instructors, PBL teaching method or samples drawn from different populations) between the two PBL sites. There are contradictions as the authors claim an advantage of the study

> "...was that PBL had been uniformly performed..."(ibid, p54.)

though they also noted differences in the delivery of PBL as the education was provided in more than one location. It is difficult to accept from Szogedi et al (2010) work a PBL approach provides better learning of resuscitation.

Sardo & Dal Sasso (2008) also report a descriptive exploratory study into the use of PBL with twenty-four nursing students in Brazil learning cardio-pulmonary resuscitation. With no comparator group or inferential statistics it is not possible to accept PBL is a more effective method of nursing students learning resuscitation. The participants appear to be senior students as they are referred to as

> "... regular students of the 3rd stage of the undergraduate Nursing course"
> (ibid, p778)

who may have previous exposure to resuscitation education and actual clinical resuscitation events, with the research investigating refresher training not the initial acquisition of resuscitation knowledge.

The PBL approach investigated by Sardo & Dal Sasso (2008) consisted of five encounters each lasting three hours and whilst a range of situations (adult cardiac arrest, manikin practice and special circumstances) were included, it could be argued too much detail was provided. For example a nursing student is unlikely to be involved in an out-of-hospital accident or gas poisoning and according to Buck-Barrett & Squires (2004) most nurses and doctors will infrequently encounter a collapsed adult even in the hospital environment. Though this research is from Brazil, the system of hospital care is likely to be similar to that experienced in the UK. The participants did report satisfaction with many aspects of the course (structure, content, tutors teaching ability) though without formal analysis of the learning effect it is not possible to conclude that PBL improves the acquisition of resuscitation knowledge. It may be the student engagement, self-instruction and small group aspects of PBL identified by Szogedi et al (2010) and Sardo & Dal Sasso (2008) enhance resuscitation learning and a student designed RLO may also exploit this.

2.2.2.4 Online, Feedback and Short Repeated Practice

Much literature discussed below reports aspects of a large scale research project in the USA funded by the National League for Nursing, the AHA and Laerdal Medical. They investigate the use of an AHA online education programme with manikin feedback and short repeated practice, showing promise when nursing students learn resuscitation. Oermann, Kardong-Edgren, McColgan et al (2010a) describe the use of an AHA online learning package with voice advisory manikins for nursing students to learn resuscitation, suggesting self-instruction as a viable alternative to instructor led resuscitation education. Cason and Baxley (2011) also demonstrated the opportunities afforded by online courses providing accessible and effective learning to nursing students, with research in the UK (Bowden, Rowlands, Buckwell & Abbott, 2012; Cook, McAloon, O'Neill & Beggs, 2012; Paul, 2010) ascertaining student views of bespoke resuscitation learning packages.

The effectiveness of online and manikin feedback resuscitation training is investigated in a large scale cluster randomised trial across 10 Schools of Nursing in the United States of America (Oermann, Kardong-Edgren, Odom-Maryon et al, 2010b). The nursing students were randomly assigned by school to receive either tutor (control, n=339) or online with manikin feedback (intervention, n=264) basic life support education. The results demonstrated intervention participants were able to perform significantly better than those who received tutor instruction on important BLS interventions including more ventilations with no errors (7.9 - intervention versus 16.4 - control, $p=0.02$), more compressions with no errors (150.8 versus 82.9, $p=<0.001$) and fewer incorrect hand positions during compressions (25.6 versus 51.5, $p=0.01$). This work supported the acquisition of resuscitation knowledge using online resources and manikin delivered feedback.

A further aspect of this large scale study investigated the effect of short monthly practice on a manikin by testing participants at quarterly intervals reported by Oermann, Kardong-Edgren & Odom-Maryon (2011) in *Resuscitation* [and by Oermann, Kardong-Edgren, Odom-Maryon et al (2011) in *Nurse Education Perspectives*]. Their analysis demonstrated regular manikin practice by nursing students maintains adequate CPR skill

performance and though both groups maintained this after three months, the control group participants were not able to ventilate a manikin as effectively and delivered compressions significantly less well when assessed at nine and twelve months. The authors acknowledge possible limitations of inadvertent instructor influence during monthly practice using the voice advisory manikins. This was despite a clear research protocol and the effect different instructors delivering the control group education twelve months after the initial education could have on the results. This highlights the need for standardised resuscitation education resources and instruction though whether this education is best received from a student or tutor designed RLO or another approach remains unclear. Whilst this research by Oermann and colleagues appears to demonstrate a positive learning effect of monthly practice, there needs to be investigation into how students' best initially acquire knowledge on which to base their CPR skill performance.

Another publication by Montgomery, Kardong-Edgren, Oermann & Odom-Maryon (2012) based on the large scale research project described above, investigated the students satisfaction of the resuscitation training received with 348 students from the control and the experimental group returning evaluations. The authors suggest Bandura's social cognitive theory (Bandura 1977) explaining competence as a function of skill and a belief in one's abilities is directly applicable when learning resuscitation. There were more participants' responses in the control group (tutor education, n=194) than the intervention group (self-instruction and voice advisory manikin, n= 144) evaluations with students in the control group significantly more satisfied (95% versus 87%, $p=0.01$) with their education than the intervention group. These findings echo Moule & Gilchrist (2001) where some instructor contact in resuscitation training was preferred. Less surprisingly, an increase in confidence in performing CPR was highly significantly for students who undertook monthly practice as against those who did not, perhaps identifying a link to Bandura's theory. One respondent also reported preferring specific feedback rather than just being advised by the automated manikin their intervention was incorrect, highlighting the importance of designing resources to meet the learner's needs.

Both the "monthly practice" and the "no practice" group provided similar short answers when asked how the training could be improved, with no comment expressed by the largest number (over 30% of participants)

suggesting they were satisfied with their educational experience. However, participants from both groups expressed a desire for more instructor involvement supporting a blended learning approach. To remove the teacher completely seems a step too far and a blended learning model of education where students acquire knowledge from face to face interactions (lectures, seminars, practical skill session) and from self-directed learning (guided study using identified educational resources such as RLOs and literature) appears to be preferred.

Separately from the above studies by Oermann and colleagues, Cason & Baxley (2011) report research into the effectiveness of BLS Anytime™ for Healthcare Providers that requires internet access to view the online resource, a DVD and an inflatable resuscitation manikin. A convenience sample of eighty-eight learners with nursing students comprising just under half the sample (n=39) used the package to achieve initial certification of resuscitation competence. Both groups achieved a high pass rate on the knowledge assessment though the nursing students performed significantly less well in delivering adult CPR when assessed by AHA certificated instructors. However as this does not appear to have been assessed using a valid and reliable tool it is more difficult to accept the conclusions. One aspect of infant CPR (airway opening and breathing check) was performed more effectively by the student learners than the recertification learners who were predominately nurse faculty, suggesting possible links to the work by Wynne et al (1987) where competence in CPR was not associated with seniority. A limitation of this research was participants used the educational package in a computer laboratory negating the flexibility implied by the name BLS Anytime™ online education provides. Learners not only require control over what and how, but also where and when they learn as acknowledged by the authors in their conclusions.

Highlighting the importance of the design of resuscitation education, Cook et al (2012) describe an online resource and the learning effect it can confer on the knowledge of participants undertaking an Immediate Life Support (ILS) course. Though the resource was aimed at senior nursing students undertaking more advanced resuscitation interventions, the principle of using RLOs to acquire knowledge was tested by randomly allocating 18 participants (the experimental group) access to RLOs two

weeks prior to undertaking their course. In total, there were 34 participants, with the instructors assessing the students abilities in eight skill stations blinded to who used an RLO in acquiring particular resuscitation knowledge. In three stations there was a significant difference favouring the experimental group abilities (checking equipment, $p=0.014$, airway opening, $p=0.03$, and defibrillator use, $p=0.048$) suggesting use of the RLO achieved improved learning. Cook and colleagues believe being able to perform a skill competently is underpinned by knowledge, supporting a view research should be directed as to how established knowledge is most effectively acquired prior to practicing a skill applied to clinical practice.

Appropriate and timely feedback is appreciated by students though when performing a skill without a structured review process it can be difficult for a teacher and a student to accurately recall what has or has not been done. Bowden et al (2012) report research that allowed a student and teacher to view a video online of the student's performance after the learning event. Ten medical and three nursing students participated in this research with five individual interviews and two separate focus groups subsequently convened to discuss the process. Only one comment by a nursing student was reported and there were acknowledged limitations to the work, though it does highlight the importance of reviewing a learner's performance in a calm and unhurried way. This is true for the teacher as well as the learner as both will be more informed to discuss the participant's performance. Registered Nurses appear to value debriefing and feedback to improve resuscitation learning according to Dine, Gersh, Leary et al (2008) and is reasonable to suggest nursing students also benefit from this process given the importance reflection plays in nurse education (NMC 2010).

Leighton & Scholl (2009) investigated 28 nursing students' experience of participating in a simulated cardiac arrest event and elicit their views by administering a questionnaire and analysing the post simulation debriefing session. Findings similar to Page & Meerabeau's (1996) (Section 1.2.6) investigation of Registered Nurses and nursing students' experiences of clinical cardiac arrest events were identified with participants not feeling confident in their actions if a patient collapsed beside them, a lack of knowledge of their roles and overall expressing feelings of inadequacy.

Analysis of the demographic data identified participants with previous exposure to resuscitation and those with more than four years healthcare experience expressed an increased confidence if required to perform CPR, though the difference was not significant. In small groups the participants were exposed to a simulated scenario of a patient unexpectedly collapsing and it was not possible to ascertain an individual participant's performance. However there were noted deviations from the current guidelines including delivering compressions prior to ventilating the manikin (contrary to guideline at that time), no call for assistance and a mean delay of 83.2 seconds (range 35 to 152 s.) before responsiveness was assessed. Though nine of the ten groups initiated CPR within three minutes meeting the current AHA guidelines, participants did not achieve overall competence despite possessing a current CPR certificate. As these results describe similar findings to that identified by Abella (2005a; 2005b), the effectiveness of current resuscitation education has to be questioned.

Another small scale study reported by Paul (2010) explored the experiences of six accelerated pre-registration nursing students' exposure to a formative resuscitation assessment. There was a divergence in the tutor and the students' assessment of their performance using the same checklist, with five students identifying they achieved the pass criteria whereas the tutor only assessed two students as doing so. Though a small scale study employing un-validated assessment tools, the divergence between the perceived and actual ability of the students indicates deep learning may not have occurred even though they had received clinical skills teaching. There are acknowledged limitations to Leighton & Scholl (2009) and Paul (2010) studies though the results appear similar to other resuscitation education research, highlighting the need to investigate how knowledge is best initially acquired by nursing students.

Allen, Wong, Aves & Dorian (2012) reported to conference in a poster the success of feedback in teaching basic life support to medical and nursing students (n=298) randomised to one control and two intervention groups. There is insufficient detail to fully understand the complexities involved though the work does suggest an increasing interest and potential feedback may play in effective resuscitation training, whether that is delivered by a tutor or is automated using technology.

2.2.2.5 Peer Instruction.

A different form of student-centred learning is described by Perkins, Hulme, Shore & Bion (1999) where senior healthcare students who have excelled on their basic resuscitation education undergo additional instruction to deliver this course to junior peers. Students selected undertake a programme provided by an external organisation teaching potential student instructors presentation and basic educational theory before practicing resuscitation education skills. Completion of the programme by the senior student is recognised by the award of an instructor certificate accredited by the independent external course provider and formal acknowledgement from the University of their teaching ability.

Perkins et al (1999) report very positive junior students' evaluation of the programme with the vast majority of respondents (n=296, 94.6%) rating the student taught course organisation as good or very good and the teaching as good or very good (n=295, 94.3%). Additionally half the junior students undertaking the course expressed an interest in becoming instructors and though this is no guarantee they will progress on this route either due to ability or continuing desire, does suggest students are motivated to educate their peers. Novel educational methods need to be accepted by students, achieve no less learning and can provide other benefits such as being more accessible, as Perkins and colleague reported.

Perkins, Hulme & Bion (2002) demonstrated the effectiveness of student led teaching in a subsequent investigation by randomising one hundred and twenty-two junior medical, dental, nursing and physiotherapy students to receive resuscitation education from a student or clinical teacher. Those taught by a student achieved a significantly better practical exam pass rate than those taught by a clinical teacher (56/57 versus 53/62, $p=0.018$), the student instructor was significantly more likely to attend class than the clinical teacher (48/48 versus 36/48, $p=0.01$) and there was no difference in the theoretical exam pass mark. Though there was no indication if this study was adequately powered, students appreciated being taught by their peers. The authors comment on the motivation of the student instructors and postulate clinical staff may be better deployed teaching more advanced skills commensurate with their experience. Perkins and colleagues

demonstrate that established resuscitation knowledge and skills can be taught by senior health professional students who have an interest in teaching junior students, with this approach providing benefits to students, clinical teachers and the University. It is possible a peer learning type approach can be applied to the design of an RLO other students can use when learning established resuscitation knowledge, though a discussion of student designed RLO literature will follow first.

The move from classroom to small group and the use of technology in resuscitation training is clear, though whether one approach enhances the acquisition of resuscitation knowledge remains unknown. What is undeniable is the role technology can play when learning resuscitation knowledge and this will be the focus of the second aspect of this literature review.

2.3 Learning Objects and Resuscitation Summary

Involving students in the design of RLOs could produce benefits to their peers as the resulting resource may be more aligned to their learning needs. Oliver (2010) proposes teachers use a facilitative approach, rather than delivering information in a didactic fashion that may not enhance student engagement and learning. The opportunities technology allows in developing novel educational resources must be seized, if twenty-first century students are to learn established knowledge effectively and efficiently. Those developing educational resources must pay close attention to design as there should be no less learning if students are asked to access education through the use of RLOs. Technology allows the design and development of accessible resources and though the initial development costs may be high, it is possible they make more effective use of designers' and developers' time.

It is not known what educational interventions nursing students should use to learn established resuscitation knowledge they can apply in a simulated and clinical environment. Though the evidence reporting student designed RLOs is sparse, what is available offers tantalising glimpses of the potential contribution students can make in designing effective learning resources. Students can design educational resources and students value learning from their peers, whether this is from digital or non-digital resources and capturing this effect may result in RLOs more aligned to learners' needs.

A variety of approaches have been suggested to facilitate nursing students learning essential resuscitation knowledge though it is not definitively known how this is best achieved. The importance of effective resuscitation education is clear because if nurses are not able to initiate effective CPR, a patient is much less likely to survive (Resuscitation Council 2015b). Literature demonstrates nurses and other health professionals' lack of resuscitation knowledge and skill hinders their performance in simulated and clinical environment and Registered Nurses should have learnt essential resuscitation knowledge as part of their pre-registration education. Nursing students have been exposed to a range of educational methods when learning resuscitation knowledge though few studies involved students of any discipline investigating the design of RLOs. Addressing this may reveal whether student designed resource produce RLOs more aligned to learners needs and essential knowledge learnt more effectively, creating space in a curriculum to practice resuscitation interventions prior to clinical practice.

The large scale research project by Oermann and colleagues and the publications derived from it (see Section 2.1.2.4) do add to the evidence how nursing students can learn resuscitation knowledge and skills effectively in a simulated environment, though how resuscitation knowledge is initially acquired is not adequately understood. More recent research focused on improving the skill ability of nursing students in delivering cardio-pulmonary resuscitation through the use of simulation, though the resources required to deliver high fidelity simulation based education is significant, limiting its widespread adoption. Current guidelines suggest the use of resource intensive simulation interventions in much resuscitation education is un-necessary (Resuscitation Council 2015b) and by ensuring essential knowledge acquisition is most effective, students may have more curriculum time to practice CPR in a low fidelity educational environment.

Even with the publications derived from the large scale research project by Oermann and colleagues, the learning effect of self-directed educational packages remains undetermined. Novel educational approaches such as online education packages and peer education appear to show promise and are generally liked by students, though as other investigations have identified some teacher contact is preferred (Montgomery et al 2012;

Moule & Gilchrist 2001). It remains to be established what factors appear to enhance learning and who is best placed to design RLOs to achieve the most knowledge acquisition. This study aims to understand how RLOs to learn established resuscitation knowledge are designed by students and by tutors and whether a student designed resource may provide additional learning gains.

RLOs also allow a standardised approach to be employed, and if well designed negates the potential of poor instruction hindering learning, at least in the resuscitation knowledge acquisition phase. Moule (2000) in a small-scale study demonstrated the importance of nursing students accessing consistent and structured resuscitation education, employing clear feedback mechanisms for the learners. Resources can be made widely available through the use of technology and when guidelines change can be easily updated.

The challenge of identifying literature discussing student designed resources due to authors focussing on other aspects in their studies, highlights the requirement for those investigating education to report not only the acceptability of the intervention but also how resources are designed and the evaluation. The recent publication of the **G**uidelines for **R**eporting **E**vidence-based practice **E**ducational interventions and **T**eaching (GREET) seventeen point checklist provides a basis for reporting research into educational interventions that may address this deficit (Phillips, Lewis, McEvoy et al 2016) as without robust evidence to support the introduction of novel educational methods all stakeholders justifiably ask why one method should attract a greater resource than others. We are left with the impression student designed educational resources may have potential to enhance learning though are not able to support this with evidence and why this study to understand how RLOs used to learn established knowledge are best designed is required.

2.4 Research Aims

The aim of this research is to understand the pedagogical decisions made by RLO designers (see Research Question 1 in section 2.4.1) and whether a student-designed or a tutor-designed resource provides more effective learning and is acceptable to the learner using that resource (see Research

Question 2 in section 2.4.2). The acquisition of established resuscitation knowledge was an appropriate vehicle to investigate the RLO design and though other types of established knowledge such as the theory underpinning measuring blood pressure was an alternative, the reasons why resuscitation was chosen have been explained in Section 3.1.2.

To understand the storyboard creation process (phase 1), a group of nursing students and separately a group of tutors following an established methodology (see Fig. 3-2 & Fig. 3-3) and created a storyboard for the design of a reusable learning object. To investigate the learning achieved from viewing a student or a tutor designed resource (phase 2), junior nursing student participants viewed one randomly allocated RLO, completing a pre and post knowledge of resuscitation and confidence in their knowledge of resuscitation assessment and then evaluated the resource viewed.

2.4.1 Research Question 1 (RQ1) – Storyboard workshop

When assessed against Tuckman's stages of group development model and the LOAM pedagogical factors tool, how do a homogenous group of students and separately tutors function and what pedagogical factors do they discuss when creating a storyboard in the design of a learning object?

a) Which four stages of Tuckman's model do groups' use, how long do they spend in each stage and what is the character of their progress?
b) What LOAM pedagogical factors are discussed by each group and how long do they spend discussing each factor?

2.4.2 Research Question 2 (RQ2) – Learning and evaluation

What is the learning effect and acceptability of a student-designed and a tutor-designed learning object, when novice nursing students are randomised to view one RLO in learning resuscitation knowledge?

a) Is there a difference in the pre and post viewing knowledge of novice nursing student participants, who view a student-designed or a tutor-designed learning object?

b) Is there a difference in the pre and post viewing confidence in knowledge of novice nursing student participants, who view a student-designed or a tutor-designed learning object?
c) Is there a correlation between the knowledge and confidence in knowledge of novice nursing student participants, who view a student-designed or a tutor-designed learning object?
d) Is there a difference between the three cohorts' knowledge or confidence in knowledge?
e) Are learning objects an acceptable method for novice nursing students to acquire established resuscitation knowledge?

3 Methodology and Methods

3.1 Methodology overview

This research has been undertaken using a modified grounded theory methodology with an exploratory sequential and Participatory Design approach. The research comprised two distinct phases and the development of the student-designed and the tutor-designed RLO by the researcher, with the approval of the *Faculty of Medicine and Health Science Ethics Committee (Ref C/01/2011)* (see Appendix 8.3-8.7). The methods adopted undertaking this research ensured as far as possible confidentiality was maintained, no participant felt coercion to participate, informed consent was obtained, care was taken with the data and all participants were involved as fully as possible without feeling obliged to make additional contributions. These ethical principles summarised by Rudestam & Newton (2015) are applicable to all research involving human participants, whether they are patient, staff or students (Holzhauser, Winch & Henderson, 2008).

The Storyboard Workshop (phase 1) commenced with the student group and separately on the following day the tutor group, recorded for later analysis. Tuckman's stages of group development model (Tuckman, 1965) and the LOAM Tool identifying pedagogical factors (Windle, Wharrad, Leader & Morales, 2007), were used to analyse the workshop video recordings. Once the content created by each group in the storyboard workshop was collated, there was an RLO development process where the researcher used what the student-designers and tutor-designers had produced to create their respective learning object. Both resources were reviewed by an e-learning expert applying the LOAM Tool to identify the pedagogical attributes exhibited so it was possible to compare how closely pedagogical decisions made during the storyboard workshop were represented in the final resource.

When the student-designed and tutor-designed learning objects were completed, the Learning and Evaluation (phase 2) commenced with novice nursing students randomised to view one of resource before completing an assessment of their pre and post intervention knowledge and confidence in their knowledge of resuscitation and finally evaluating the resource viewed.

The analysis by the researcher of Storyboard Workshop (phase 1) and Learning and Evaluation (phase 2) data occurred after the learning object was developed to avoid possible bias. During this investigation, the student designed resource was referred to as RLO 01 and the tutor designed one as RLO 02; this was only known to the author to avoid any potential bias if it was identified which group had created the learning object.

3.1.1 Grounded Theory Methodology

The methodology adopted for this study was grounded theory used in sociology to understand essential psychological processes in a social environment (Polit & Beck, 2012). Using grounded theory to understand the decisions students and tutors make when working in distinct groups to create a storyboard provides a sound theoretical basis for the research, as little is known about how learning objects are designed. Polit & Beck (2012) describe how grounded theory has been used to understand and explain theoretical aspects of the nursing profession by focussing on the behaviour not the individual and go on to explain how the methodology can be used to understand the behaviour of a person not the person themselves. Taylor, Kermode & Roberts' (2006, p330) description of grounded theory concur with Polit and Beck's interpretation saying it

> "...attempts to make sense of what people say about their experiences and convert these statements into theoretical propositions that form a middle range theory..."

This methodology provides a way of exploring and understanding how a group designed a learning object and what pedagogical factors they discussed to develop a substantive theory that can be applied to this area.

Grounded theory as a methodology continues to evolve with discussion by Buchanan & Bryman (2009), Charmaz (1990), Polit & Beck (2012) and Parahoo (2014) whether variations of grounded theory methodology can be considered true to the original Glaser and Strauss definition. Charmaz (ibid) proposes a constructivist grounded theory methodology where researcher closely inspects their data, theory is developed from the processes identified in the data and finally they compare their results with the literature. This concurs with Denscombe's (2007) explanation of the Glaser and Strauss original grounded theory methodology suggesting researchers should be an integral part of the study, collecting data and

using this information to develop theory. They suggest a combination of observation, semi-structured interviews, focus groups and quantitative data with the emphasis on acquiring quality data suggested by Birks, Chapman & Francis (2006) and Sandelowski, Barroso & Voils (2007) will promote the credibility of research with qualitative observation and acquisition of quantitative data prominent in both phases of this research.

Key aspect of grounded theory includes 1) the emergence of theory from the data collected, 2) the collection and analysis of the data occurring at the same time, 3) constant comparison allowing the identification of core categories, basic social processes and the combination of these towards theory development and 4) theoretical sensitivity where the conceptual theory developed provides as much detail as possible on the area of investigation.

Parahoo (2014) suggests rigour in grounded theory can be achieved by careful use of the methodology and clear explanation of the methods used when data is acquired, categorised and presented. Parahoo (ibid) highlights Glaser and Strauss suggestion grounded theory research should be evaluated in the following four categories of fit, workability, relevance and modifiability. 'Fit' can be considered how the theory is linked to the area researched, with 'relevance' described as the theory is identifiable to those use it (in this case tutors, learning technologists and students). Workability' defines how the theory could be applied to similar situations and 'modifiability' indicating how the theory could evolve. Member checking is avoided as the comments of the participants should be taken at face value and only during the RLO development were phase 1 participants opinions sought to ensure what was developed reflected their design.

A divergence between Glaser and Strauss, the original authors of grounded theory led to methodological concerns discussed by Duchscher & Morgan (2004) who question whether a Straussarian approach adopting a reductionist stance can be considered grounded theory true to the original definition. This view has been contested by Cutliffe (2005) suggesting tensions arise when taking a true Glaserian approach, particularly where ethics committees familiar with biomedical research proposals require specific questions to be asked, with the suggestion research following Strauss and Corbin methods is better described as modified grounded

theory. A clear explanation and critique of grounded theory contrasting the classic approach with that subsequently developed by Strauss and Corbin is provided by Holloway & Galvin (2015) who suggest the decision which approach to use is ultimately up to the researcher. Consequently a modified grounded theory methodology has been adopted as i) an understanding how storyboards are created may emerge during the research ii) the project was undertaken in a predominately medical and scientific environment and iii) the lack of literature investigating how a storyboard is created highlights the need for this work.

3.1.2 Exploratory Sequential Design approach

This research adopts an Exploratory Sequential Design approach described by Creswell & Plano-Clark (2007) with qualitative observation during the Storyboard Workshop (phase 1) and quantitative evaluations establishing learning and acceptability of a resource as a result of viewing one learning object (phase 2) - Figure 3-1. By applying a methodology to understand how a storyboard is created and what pedagogical factors were discussed by a group of students and a group of tutors and then measuring the learning that occurs, opportunities may be identified and exploited by others designing learning objects to acquire established knowledge.

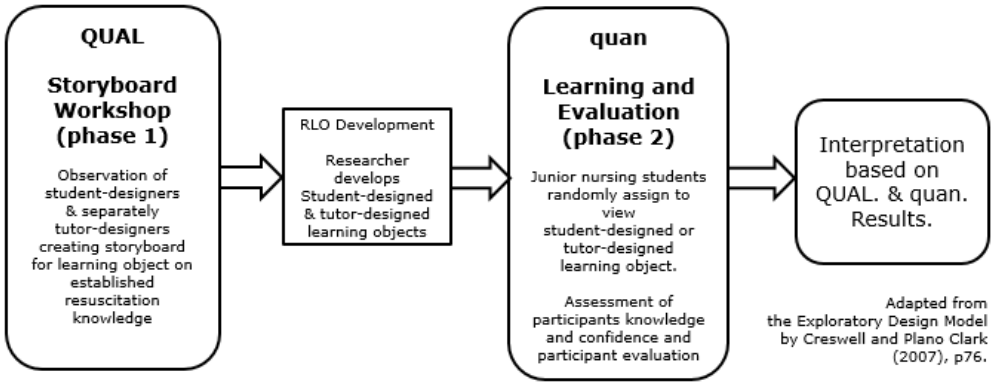


Figure 3-1 Exploratory Sequential Design model
The Exploratory Sequential Design commences with the qualitative storyboard creation process (phase 1), moves on to the RLO development by the research team and finally enters the quantitative RLO learning changes and user evaluation (phase 2), with the results of this research based on combining the qualitative and quantitative aspects of this work.

3.1.3 Participatory Design

Participatory Design began as a political and social phenomenon in the 1960s Westernised countries, where individuals demanded a greater involvement and wished to influence processes that affected their lives.

Subsequently an interest from academics led to designers and design researchers considering how participation from those directly affected could contribute to a project, notably in the field of architecture and computer science (Robertson & Simonsen, 2012). Adopting a Participatory Design methodology described by Schuler, Namioka & Hillsdale (1993) facilitated the involvement of an end user of a resource in its creation and addressed the problem of designers of a new system having to "second guess" what the end user actually wanted the technology to do (Dix, Finlay, Abowd & Beale, 2004). Muller & Druin (2012) highlighting how Participatory Design can be utilised in the design of educational resources, with the inclusion of the user as a vital component and not just an afterthought.

More recently, a participatory approach has been used to understand how theory informs practice and vice versa when Cook, Mor, Santos et al (2016) reported the application of Participatory Patterns Design methodology to understand how national healthcare guidelines were applied to a local area by General Practitioners. With individual's increasing desire to mould the world they inhabit, Participatory Design provides a suitable methodology to achieve this end (Robertson & Simonsen, 2012), though to investigate the potential differences in how learning objects are designed it was necessary to understand the decisions of designers.

The adoption of a Participatory Design approach allows the students' voice to be heard, separately and distinctly from the tutors to avoid any perception of bias. By asking a group of students and separately a group of tutors to create a storyboard in the design of a learning object (phase 1 of this investigation) there was no influence from one group on the other and the voice of the designers was clear, visible and untarnished. Deciding to include a student group with sole control of the design of their learning object in the Storyboard Workshop (phase 1) could have raised concern over the accuracy of content, though as the design process in this investigation adopted a robust methodology that included a peer review process (see section 3.1.7 & 3.2.2), this risk was avoided.

The student voice is becoming more visible in the post-compulsory education sector in the twenty-first century primarily due to societal changes, technology and because social constructivism learning theory has assumed a higher profile. This means it is essential to examine the student

and tutor group separately as it would not be possible to untangle the pedagogical decisions made if the each designer group participants included students and tutors. It may be features of one groups' design decisions are uncovered and it is this that enhances a learners acquisition of knowledge when learning objects are used. Designers can then create learning objects incorporating this new knowledge in the design stage.

The inclusion of the learners' voice in designing education has been muted (Conole, de Laat, Dillon & Darby, 2008; Sharpe et al, 2005), though an awareness of the contribution students can make in the design of educational resources is emerging and the importance of hearing what learners' say highlighted by Conole (2008). By promoting the role of students in the design of learning objects, it may be educational resources are better aligned to the learner's needs because their voice is then integral in the design process.

3.1.4 Models used in Assessment of Student and Tutor Groups

In the storyboard workshop (phase 1) it was essential a standardised protocol was adopted to enhance the credibility of the research and a pre-planned agreed schedule (see Section 3.2.1.2, Fig. 3-3) used for both the student and tutor groups including the same short presentations delivered by the research team. A key aspect of this research was to observe the participants as they created a storyboard to establish how each group functioned and what pedagogical factors each group discussed.

3.1.4.1 Tuckman Stages of Group Development Model

Bruce Tuckman's model of how groups develop emerged from a review of published literature over the preceding two decades on therapy, training and natural groups (Tuckman, 1965). Therapy groups comprised individuals undergoing counselling in a group environment for mental health or drug addiction problems whereas training group (referred to as T-groups) consisted of students or employees and natural groups formed to achieve a particular task. The published literature on therapy, T-groups and natural groups analysed by Tuckman enabled him to identify four stages of group development referred to as 1) testing and dependence, 2) intra-group conflict, 3) the development of group cohesion and 4) functional role relatedness. He then summarised these four stages as forming, storming,

norming and performing, ascribing the longevity and popularity of the model to the simplicity of the words used to describe each stage (Schuman, 2001).

Table 3-1 Tuckman Stages of Group Development definitions

KEY	Forming	Storming	Norming	Performing
Tuckman's descriptions (Tuckman, 1965)	orientation, testing and dependence	resistance to group influences and task requirement	openness to other group members	constructive action
Interpretation of each stage	questions, seeking opinions testing the water	clear disagreement, discomfort with-in the group	clear agreement with-in group as to progress	solutions and options suggested and general agreement as viable

The forming stage consists of the group becoming orientated to the task in hand and the establishment of ground rules for the group to function; asking questions, seeking opinions and 'testing the water'. Storming is described as an emotional response to the task demanded of the group, a lack of unity and key issues polarising group member's views. There is clear disagreement and discomfort within the group. The third stage identified as norming allowing an open exchange of relevant interpretations of the task and clear agreement within the group setting the basis for progress to be made in achieving the task in hand. The final stage, performing is where solutions emerge and there is general agreement within the group the options are viable; a summary of the four stages applied to the data can be seen in Appendix 8.11. A fifth stage of adjourning was later added to the model by Tuckman and Jensen (1977) though this has achieved less prominence. As both groups had the same defined time boundaries the adjourning stage was not relevant to understanding how a group of student and tutors function when creating a storyboard in a workshop environment with a pre-defined schedule.

The Tuckman group development model has been applied across a diverse range of environments from business (Hall, 2015), public health (Walker & Mather 2004; McMorris, Gottlieb & Sneden 2005), college computer students (Largent & Luer 2010), online learners (Michinov & Michinov 2007) and undergraduate health science students (Weber & Karman,

1991). There are many different types of group development models with Smith (2001) suggesting they can be categorised as 1) linear progressive, 2) cyclical and pendular or 3) non-phasic/hybrid models and categorises Tuckman as a linear progressive model. Hurt & Trombley (2007) review two other possible group development models, the Punctuating-Equlibrium Model and Group System Theory suggesting all could be integrated with Tuckman's model though Bonebright (2010), Garfield & Dennis (2012) and Hurt & Trombley (2007) suggests a simple hierarchical model that imply groups can only develop in a linear fashion does not capture complex dynamics of a groups development.

The simplicity of Tuckman's group development model does allow it to be applied across a range of groups and timespan over which group's function allowing other investigators to follow a reproducible and standard approach. Miller (2003) demonstrated the validity and reliability of the model providing reassurance the stages can be understood and applied to task groups. Group development models appear to have been used to understand how groups work over longer periods of time over days or weeks though with a defined start and end point Tuckman's model provides a clear theoretical foundation for this study. Other possible methods of analysing the behaviour of a group such as thematic analysis of the discussions would provide a detailed picture of what was said, but not how they actually functioned whereas Tuckman's model provides a solid foundation for this research to better understand how a group functions.

When a group forms to achieve a particular task Tuckman & Jensen (1977) suggest they will ideally progress through the preceding three stages to "performing" though this is not certain. Some degree of "forming" and "storming" is likely before "norming" and ultimately "performing" stages are achieved though Hutchings, Hall & Lovelady (2004) comment on how the earlier stages are a necessary part of team development. By identifying specific traits of each stage (Appendix 8.11) it was possible to categorise what stage each group was at during the workshop. This allowed the identification how often and how long the group spent in each stage when the recording of the student and tutor group video was analysed.

3.1.4.2 LOAM Pedagogical Factors Tool

Ellaway, Dalziel & Dalziel (2008, p180) suggested IMS Learning Design principles can be classified as a structured activity to change learners' knowledge and is situated "…between technological and pedagogical domains…". According to IMS Learning Design education can be viewed in terms of activities undertaken by participants who play roles in an environment and has been described as analogous to a theatrical play. Using these principles it is suggested a learning object consists of three main components; the Activity performed, the Environment where these activities occur and the Roles people take (IMS Global Learning Consortium 2003; Wikipedia 2013) with the LOAM Tool defining four pedagogical factors to each of the three main components (Table 3-2, Appendix 8.12). The LOAM Tool provided a structured approach to categorise the discussions of the designers for this investigation.

Table 3-2 LOAM Pedagogical Factors Tool

ACTIVITY	ENVIRONMENT	ROLES
Alignment How well any assessment covers aspects pf the learning goal.	**Media-richness** A determination of the quality of included media.	**Self-direction** How much choice the learner has when using the RLO.
Assessment To what extent an assessment was included.	**Context** How congruent the learning was with the background.	**Feedback** The level and degree to which feedback responds to the learner's needs.
Navigation How the user could navigate around the RLO and how much control the user has.	**Integration** The extent to which different types and quality of media are included.	**Support** The level of support or instruction available to the learner.
Interactivity The degree to which the design of the RLO allows the user to interact with the resource.	**Objective** How well the content reflects the objective of the resource.	**Pre-requisites** The degree of prior knowledge required to effectively use the RLO.

The Activities sub-heading includes the following pedagogical factors; alignment, assessment, navigation and interactivity. As the sub-heading implies these factors described activities undertaken by the learner and how aligned the learning object's goals are to the learning. Environment includes what the learner's experiences are in the richness of the media, how this is contextualised, whether the elements are well integrated into the resource and if the objective of the resource achieves the learning goal. The final sub-heading of Roles describes what the user requires to make

best use of the learning object, probing how self-directed they need to be, what feedback or support is required and whether there are any pre-requisites required to make most effective use of the resource. By applying this model to the storyboard workshop, it is possible to identify what pedagogical factors each group discuss and for how long, providing an insight into how a group of designers believe these elements should be portrayed in the initial design of an learning object.

A search for an learning object evaluation tool[4] revealed limited results from SCOPUS and CINAHL databases, with literature focussed on the reuse of equipment in health care. When literature was identified the papers discussed the impact on learning resulting from the use of RLOs, not evaluating an RLO per se and attention was focussed on the Learning Object Attributes Metric (LOAM) Tool devised by Windle et al (2007). Currier & Campbell (2005, p85) comment on there being no "…widely agreed evaluative criteria available." and there appears to be limited progress even a decade on. Kurilovas and colleagues do report a Multiple Criteria Evaluation of the Quality of Learning Software evaluation process with three main headings of Internal Quality, Quality in Use and Intellectual Quality and a number of sub-headings categories based on their work (Kurilovas & Serikoviene 2013; Kurilovas, Bireniene & Serikoviene 2011; Kurilovas & Dagiene 2010). However, their approach and methodology resulted in a more complex tool to evaluate learning objects.

3.1.4.3 Kirkpatrick Training Evaluation Model

To frame the discussion of knowledge acquisition and acceptance of the learning objects, Kirkpatrick's Four Level Evaluation model was used. This model was originally published in a series of articles in 1959 (Kirkpatrick, 1996) – subsequently reviewed fifty years later by Kirkpatrick & Kirkpatrick (2009) – and proposed a method of evaluating training and development by ascertaining the effect on an individual and organisation (Table 3-3).

[4] Search terms used: "RLO OR reusab* OR re usab* OR re-usab* AND learn* AND object* AND develop* AND evaluat*"

Table 3-3 Kirkpatrick's Training Evaluation Model

Level 1 Reaction	Established what the participant in the training thought of the process often with a Likert scale for the individual to indicate their level of enjoyment of a session.
Level 2 Learning	Assessing changes in knowledge, skills and/or attitudes in relation to the training.
Level 3 Behaviour	Observing the effect training has on the behaviour of an individual's in practice.
Level 4 Results	Identifying the effect of training has on the productivity of an organisation.

Note. Adapted from Tamkin, Yarnall and Kerrin (2002).

Tamkin, Yarnall and Kerrin (2002) also review other evaluation models with some appearing developments from Kirkpatrick's model though with the focus of this research on identifying how students and separately tutors design an RLO, applying an established model provides a solid foundation for comparisons to be made. As this study focusses on how participants' knowledge changed and their evaluation of the resource viewed, Level 1 (Reaction) and Level 2 (Learning) components of Kirkpatrick's model were most relevant.

3.1.5 Observations

Analysing behaviour has established roots in animal research though Martin & Bateson (2007) argue the use of behavioural research by those studying human behaviour is motivated through not only understanding the underlying physiological mechanisms but the effect of these processes. They illustrate this by stating

> "Perfect knowledge of how many times each letter of the alphabet recurs on this page would give no indication of the text's meaning. The letters must be formed into words and the words into sentences." (Martin & Bateson 2007, p3)

In the study of human behaviour the use of observation is well established with Gray (2014) describing the approach as participant or structured; participant observation interprets human behaviour whereas structured focusses more on the frequency of certain behaviour. Despite the well-known limitation of the "Hawthorne effect" from a study of factory workers in 1939, observation is an established part of research and professional practice according to Parahoo (2014) and is the main method used to analyse the storyboard workshop video in this research.

Real-time observation was one possible approach and coding would have occurred as the storyboard workshop progressed though another researcher would have been required as each group's behaviour was analysed using two models; it was not feasible for one researcher to apply more than one model concurrently in real-time and was why video recording was selected for this investigation. In real-time informal insights can be seen when observing a group, though retrospectively analysing behaviour on video with behavioural analysis software allows a researcher to review sections on more than one occasion and achieve a more accurate representation of the group work (Noldus et al, 2000; Uitterhoeve, et al 2008).

By applying observation to investigate the learning object design process and then assessing the learning and acceptability of a student-designed and a tutor-designed learning object, it was possible to identify where one resource may differe from another and if these differences can be exploited to enhance learning. Participant and structured observation will be applied to the storyboard creation video with the group behaviour, actions and discussions interpreted through Tuckman's stages of group development model and the Learning Object Attribute Metric (LOAM) Tool. This will allow the author to categorise how the group functions and what pedagogical factors are discussed during the RLO design.

3.1.6 Video and Observer Behavioural Analysis Software

Martin & Bateson (2007) highlight five methods of capturing behavioural data for analysis including video recording, transcription of the events, automated recording devices, check sheets and computerised event recorders. For this research a video recording of the workshop allowed a durable, lasting record of the work each group undertook for later analysis. The use of audio recording with no video capture could have resulted in data that was more difficult to analyse as there would have been no visual clues available to support for decisions taken by the author when analysing the storyboard workshop recordings. Check sheets, automated and computerised recording devices can be used to establish whether an action did occur, but would not provide the detail to investigate how students and separately tutors created a storyboard and are more suited to animal research or investigating structured processes (e.g. how often a sanitising hand dispenser is used in a clinical environment). Cohen, Manion &

Morrison (2005) highlight how powerful an audio-visual recording of observations can be, providing the ability to review a groups' behaviour in a calm and controlled manner. The possible intrusive nature of video recording equipment is allayed by using facilities with in-built unobtrusive ceiling mounted camera; closed circuit television (CCTV) is ubiquitous today whilst one must acknowledge the different reasons for its use in research and more generally in society.

The use of Observer™ behavioural analysis software (Noldus, The Netherlands) allows a researcher to analyse the behaviour of a group in a controlled manner (Noldus, Trienes, Hendriksen et al 2000). Complex interactions can be analysed by creating a theoretically based coding schemata within the behavioural analysis software. This coding schema can be applied to the video recording, uploaded and linked directly to the video recording frame by frame for subsequent analysis or review. By recording each group's behaviour during their storyboard creation workshop and analysing the video recording using Observer™ software, it is possible to apply more than one model, an approach that would not be possible if undertaken in real-time by only one observer.

The use of Observer™ software is reported in animal and human research, with a brief search of SCOPUS using "Observer AND Noldus" revealing 37 paper where this software was integral to the study. They include an investigation of interventions for people with dementia (Moyle, Beattie, Draper et al 2015), better understanding micro teaching in a health science curriculum (Hooper, Greene & Sample 2014) and learning how deaf signers read (Ducharme & Arcand 2009) in addition to studies of children and of animal and six technical report about the use of Observer™ software. Church, Martz & Cook (2006) advise caution as moving to a digital platform may not be a simple matter with digital files not able to be viewed easily due to technical difficulties. However, the progress of technology over the last decade may mitigate problems of incompatibility between systems.

An example of how video recordings and Observer™ software have been used in research can also be found in Uitterhoeve, de Leeuw, Bensing et al's (2008) investigation of oncology nurses behaviour during interviews. The detailed data collected was uploaded to the behavioural analysis software and coded against their chosen framework though as more than one rater was used to analyse the dataset, they performed reliability

checks to confirm those coding the behaviour on video performed this in a consistent manner. The lack of literature discussing how storyboards are created when designing RLOs indicates an under investigated area despite the demand in the twenty-first century for digital learning resources, highlighting the need for this research.

3.1.7 RLO Development Methodology

A formal search[5] using SCOPUS for a methodology of designing RLO (limited to sociology, art and humanities and psychology subject areas) revealed 97 papers though little discussion of the RLO development process. Currier & Campbell (2005) evaluated a number of JISC funded Distributed National Electronic Resource projects and the majority of the literature identified focussed on the use of technology in learning rather than suggesting best ways to design resources. A methodology has been developed by Wharrad & Windle (2010) and was used by the researcher to develop the student-designed and tutor-designed learning object (Figure 3-2.)

[5] Search terms used: "RLO OR reus* OR re use* OR re-us*AND learn* AND object* AND methodology*"

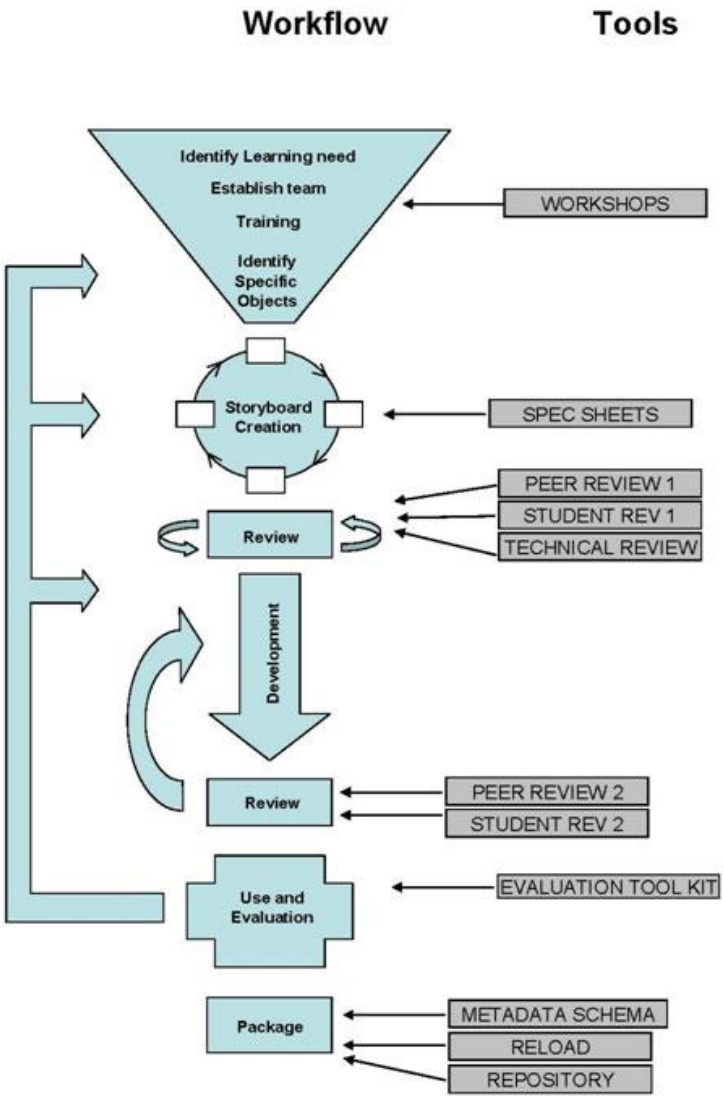


Figure 3-2 Agile Development Method
Figure 3-2 displays the Agile Development Method (Boyle et al, 2006; Wharrad and Windle, 2010) described the process of creating and developing a learning object from the initial inception to its eventual use, with an iterative process allowing continual refinement. Each stage is identified in blue with more detail provided on the right in grey.

Other evaluative processes such as MERLOT (2016) describe a peer review process and host a wide range of learning objects though do not appear to provide a complete learning object development process; consequently the Agile Development Method (Boyle et al, 2006; Wharrad and Windle, 2010) was adopted for the production of the student-designed and tutor-designed RLO.

3.1.8 Pre and Post-testing Knowledge and Confidence

To establish whether a learning object confers benefits for the user a measure of their learning as a result of the intervention is necessary. A

user's knowledge of the subject prior and immediately after viewing a learning object can provide evidence of learning though the assessment of knowledge must be fair and robust. Similarly, the individual's confidence in their knowledge will provide a gauge of how effective an educational resource has been. A disparity between an individual's knowledge and confidence score is of particular interest as further research may highlight reasons why and how this can be addressed. Though pre and immediate post-testing knowledge as part of research provide no guide to the longer-term retention of specific information and learning, demonstrating a difference in knowledge as a result of viewing one learning object allows comparisons to be made between difference interventions, in this case a student-designed and a tutor-designed resource.

A pre and post-test design may be criticised because the participants increase their learning from being exposed to a similar set of questions before and after the intervention. To guard against familiarity the questions presented to participants were re-ordered as there was a short time period between the completion of the pre and post intervention knowledge assessment. However those who viewed the student-designed and tutor-designed learning object were treated in exactly the same manner when completing the knowledge and confidence assessments. It is the similarities and differences in the initial design of the learning object that may have influenced learning that is under investigation. This investigation where the participants were randomly allocated to view either the student-designed or tutor-designed learning object strengthened the internal validity of the research according to Gray (2014). As this research investigated how storyboards are created and there is little previous work, it is not possible to confirm which learning object should be considered the control and which the intervention; consequently two-tailed statistical tests results were used to enhance the reliability of the results.

Measures of knowledge were designed and piloted to establish objectivity as they should provide a clear assessment of an individual's knowledge of an area. Questions should be in the form of a statement including sufficient detail without being unnecessarily complex, and exclude multiple concepts with no ambiguity in the answer; these are best described as closed questions (Cohen, Manion & Morrison, 2005). A common method of establishing a research participant's knowledge is by asking them to

complete a dichotomous or multiple response assessment; the question should be designed to test the knowledge of the subject not on how well they can decipher the question being asked. Assessing knowledge using this tool can be part of an online learning package by assigning 1 mark for a correct answer, -1 for an incorrect answer and no penalty (0) for an unsure response. The individual and the sample overall score can be easily aggregated for analysis allowing comparison between different groups. There is debate about the value of negative and number right marking (Lesege, Valcke & Sabbe, 2013) though where guessing a correct response could lead to harm, the inclusion of an 'unsure' option a method for highlighting knowledge deficits in the education of health professionals (McHarg, Bradley, Chamberlain et al 2005; Tweed, 2006).

A measure of confidence is by its very nature subjective as it will be the individual who decides how confident they are in their knowledge. To measure confidence a semantic differential rating scale was used with a clear statement asking participants to indicate how confident they were with their resuscitation knowledge. This was indicated by circling a number between 1 (no confidence) and 10 (total confidence) in their resuscitation knowledge. A semantic differential rating scale has an adjective beside the lowest and highest score as opposed to a Likert scale that includes a description for each positional response (commonly 1 strongly disagree to 5 strongly agree). By adopting a semantic differential rating scale, a simple statement can be made and the participant can indicate their response that can then be analysed.

Confidence in one's abilities and competence in performing basic resuscitation interventions on a manikin has been shown by Wynne et al (1987) not to be correlated, with later work by Leighton & Scholl (2009) identifying participants' perceived a lack of confidence in their actions if faced by a resuscitation event. Montgomery, et al (2012) demonstrated with regular practice participants felt more confident when performing CPR and so establishing if a student-designed or tutor-designed learning object results in additional confidence and is associated with an increase in their knowledge allowed additional insight into what factors are important in the design of an RLO.

When the student-designed and tutor-designed learning objects were used by novice nursing students, a quantifiable measure of learning can be acquired through an assessment of pre and post viewing resuscitation knowledge and self-reported confidence of their resuscitation knowledge. This component (phase 2) of the research adopted a quantitative experimental approach as the participants were randomised to receive either the student-designed or tutor-designed learning object and the data was analysed using descriptive and inferential statistics.

3.1.9 User Evaluation

Additional data gathered from the phase 2 participants reported the usability of each resource and when combined with the statistical results, provides insight to determine what the user may find helpful to their learning.

How learners engage with RLOs is essential to understand as just for commercial web sites, the usability of a resource will contribute to how easily it is accessed and enhance students learning. A resource with credible content will be of little use if it is difficult to navigate between pages, the content is of poor quality or there is little feedback for the user. Mayhew (2012) discussed the need for an excellent experience for those who visit e-commerce sites and it is no different for educators and organisations who wish to improve student learning through easy to use educational resources. An evaluation process should provide sufficient detail to be useful whilst not so onerous that the participant does not feel able to complete. By following a validated tool developed by the Health E-Learning and Media Team (undated), participants' experiences of the student-designed and tutor-designed RLO was gathered as part of this research.

3.1.10 Why resuscitation and nursing?

Resuscitation training during pre-registration nurse education was selected as the most suitable vehicle to understand student and tutor designers pedagogical decisions because:

a) it is recognised that health professionals and health professional students do not perform well in a training or in a clinical

environment and by investigating and understanding how learning resources are designed and what appears most effective, this problem may be addressed (Section 1.3.4, 1.3.5 & 2.2)

b) the knowledge base underpinning resuscitation is well established, with widely accepted international guidelines produced by the International Liaison Committee on Resuscitation (Section 1.3.1 & 1.3.2)
c) nurses are most likely to initiate hospital resuscitation attempts and if their knowledge acquisition can be improved a larger population may derive benefit (Section 1.3.3 & 2.2)
d) resuscitation knowledge must be acquired by nursing students prior to practice on a manikin and use in a clinical environment (and this is also true for all health professional students, though this investigation will confine itself to nursing)
e) the researcher's clinical career was as a Registered Nurse working in emergency care, after which I was appointed Resuscitation Officer prior to moving into academia where pre-registration nurse education is a core aspect of my professional life

If nursing and other health professional students are able to learn established resuscitation knowledge more efficiently and effectively using a learning object more aligned to their needs, they may be more able to apply this knowledge in a simulated environment before commencing clinical practice (though it must be emphasised this study was to investigate how learning objects are designed).

3.2 Methods

This section will explain the methods used for this investigation, based on Rudestam & Newton's (2015) guidance on how to present methods in a thesis. A description of how this investigation was undertaken is displayed in Figure 3-3 below with the chronological path displayed from left to right. Once ethical approval was agreed (see section 3.1), the storyboard workshop (phase 1) commenced in autumn 2011 (section 3.2.1), followed by the researcher developing the student-designed and tutor-designed learning objects in 2012/2013 (section 3.2.2) and concluded with the learning and evaluation (phase 2) component in 2014 (section 3.2.3). Formal analysis was undertaken only when all data (storyboard workshop and learning and evaluation phases) was collected and the student-

designed and tutor-designed RLO developed, so there would be no influence on the final learning objects.

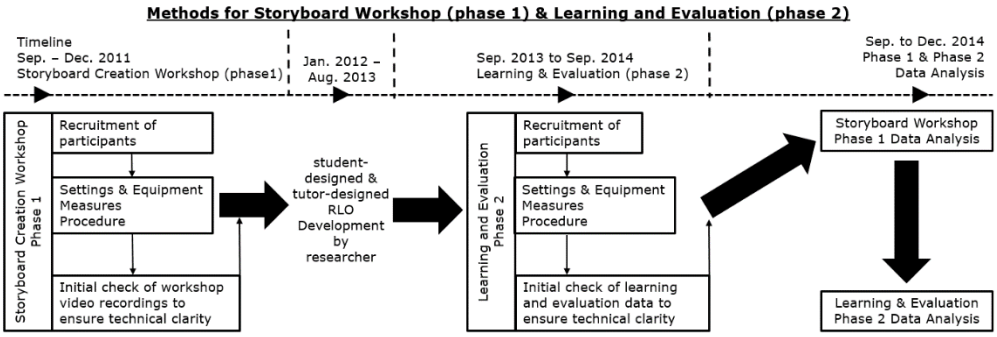


Figure 3-3 Methods for Storyboard workshop and Learning & Evaluation
Figure 3-3 displays the storyboard workshop (phase 1), RLO development by the researcher, the learning & evaluation component (phase 2) and the analysis of the data, completed in 2014. Above the dotted horizontal line is a time line, with the two phases separated by the development of the student-designed and the tutor-designed RLO below the horizontal dotted line, with arrows indicating the progression of the investigation.

3.2.1 **Storyboard Workshop (Phase 1)**

3.2.1.1 Participants

To recruit of participants to the storyboard workshop the researchers delivered a short presentation at the start of a lecture and circulated a flyer explaining the research project, emphasising there was no obligation to participate. Lectures to second, third and fourth year pre-registration nursing students at the start of Semester One (September and October, 2011) were identified in module timetables by the researcher. The lecturer was contacted to request permission to speak with students, so their planned learning was not disrupted. A five-minute presentation was delivered to the students, accompanied with the distribution of a small advert explaining details of the research project (Appendix 8.8). The presentation and advert described what participation in the research project would involve and potential benefits for students participating in the storyboard workshop planned for November 2011. In a similar fashion and at a similar time the research project was publicised to nurse tutors through established networks and staff meetings. Students and tutors who expressed an interest in participating could request further information by emailing or texting the researcher when they would be sent full information about the research project and consent details, allowing them time to absorb the information and ask further questions.

The benefits of participation for students and tutors were highlighted as a valuable revision of resuscitation guidelines published the previous year and to gain a better understanding of the design of learning objects. A small inconvenience allowance (£30) was provided and a certificate of participation students could use in demonstrating their achievement of a practice outcome was agreed through the ethical approval process. All participants gained the altruistic benefit of contributing to educational research.

By publicising the opportunity to participate in a research project in large classes and meetings and providing an individual flyer summarising this information any coercion to participate was minimised. In addition as the School comprised six centres across the East Midlands and the researcher was based in a smaller outlying centre they were not known to the majority of the students through teaching or pastoral commitments. It was emphasised to all potential participants that no specific e-learning or resuscitation knowledge beyond their stage of nurse education was required as they were going to be asked to make judgements about how they believed ideas and content could be best represented in the design of a learning object that novice nursing students could use to acquire established resuscitation knowledge.

Defining what an acceptable sample size for the storyboard workshop was difficult with a small group in teaching suggested by Fry et al (2009) comprising between between two and twenty participants. In the development of Tuckman's stages of group development model, Tuckman (1965) reported three distinct types of group (therapy, natural and laboratory); laboratory groups that generally consisted of under ten members were most identifiable to this research as they were convened to perform a task. Subsequent investigations of how groups function (Jahng, 2012; Miller, 1995) reported groups comprising between three and five participants and on this basis, the aim was to recruit between four to eight participants for this investigation, that reflected a minimum number sufficient to form a group whilst not proving to be unmanageable and impractical. In total seven students and six tutors agreed to participate and presented for their respective storyboard workshop. Therefore, the intended sample size for phase 1 was achieved. When necessary to report the individual contribution of participants in section 5.3.2 (Boxes 2 to 5), a

simple S1 to S7 code was used to identify student participants and T1 to T6 to identify tutor participants, with the code only known to the researcher and all data saved on a password protected secure University network.

3.2.1.2 Setting and Equipment

For the storyboard workshop a dedicated e-learning studio with a control room was used which was accessible and in a familiar location for all participants (see Fig. 3-4). The studio and control room doors were closed to maintain confidentiality and so the participants were not disturbed. A networked computer and wall-mounted projector were available in the studio allowing the participants to view resources on the University intranet and the internet (see Figure 3-5).

The studio had two inbuilt ceiling mounted cameras and equipment to record the workshop in the adjacent control room (see Fig. 3-4 and one camera in the upper right of Fig. 3-5 is visible). With two cameras it was possible to obtain different views though as the visual and audio quality provided by camera 1 was more than adequate, the camera 2 recording was retained only as a back-up copy in case of technical issues with the primary recording. The researcher could monitor each group's progress though the live video feed recorded in the control room and through a one way mirror window between the control room and studio. Though participants' had been orientated to the Health E-Learning and Media studio and were aware the researcher was located in the control room, they did not appear to be concerned about being observed or video recorded. If it was necessary to communicate with the participants, the researcher was able to ask one of the facilitators to do so. This arrangement allowed informal observation of the group by the researcher and enabled the participants' to access support if required. The researcher was mindful, even though participants provided informed consent that being recorded could inhibit their work, though ceiling mounted professionally installed cameras allowed participants to focus on creating a storyboard for a learning object and not the presence of or another individual operating recording equipment in the room.

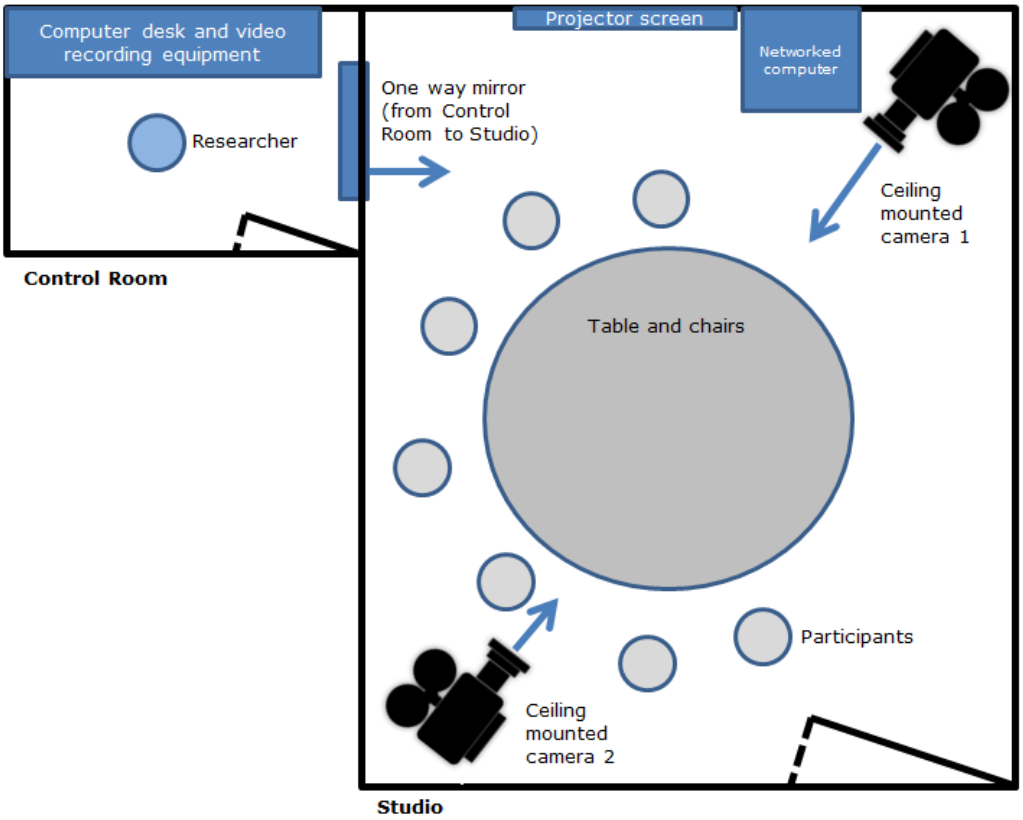


Figure 3-4 Diagram of HELM Studio and Control Room
Figure 3-4 displays a diagram of the HELM Studio showing where the participants and resources were in the room, with the Control Room to one side.

Figure 3-5 HELM Studio image.
Figure 3-5 displays an ihe image of the HELM Studio taken from the door, showing the working environment, including a networked computer, projector screen, one way mirror from the control room (on the right) and ceiling mounted camera 1.

The group were provided with a copy of current adult basic life support guidelines and Advanced Life Support manual (Resuscitation Council, 2011), though as the course manual discussed more advanced resuscitation techniques, it was emphasised they were to create a storyboard for the design of an learning object novice nursing students could use to acquire adult basic life support knowledge. As described by Leeder (2009) laminated A0 size flip charts, small A4 sized sheets with non-permanent pens and wipes and paper were provided for the group to capture their discussions (Figure 3-6). During the storyboard workshop there was space on the wall to mount their work, though both groups found it easier to work around the table in the room.

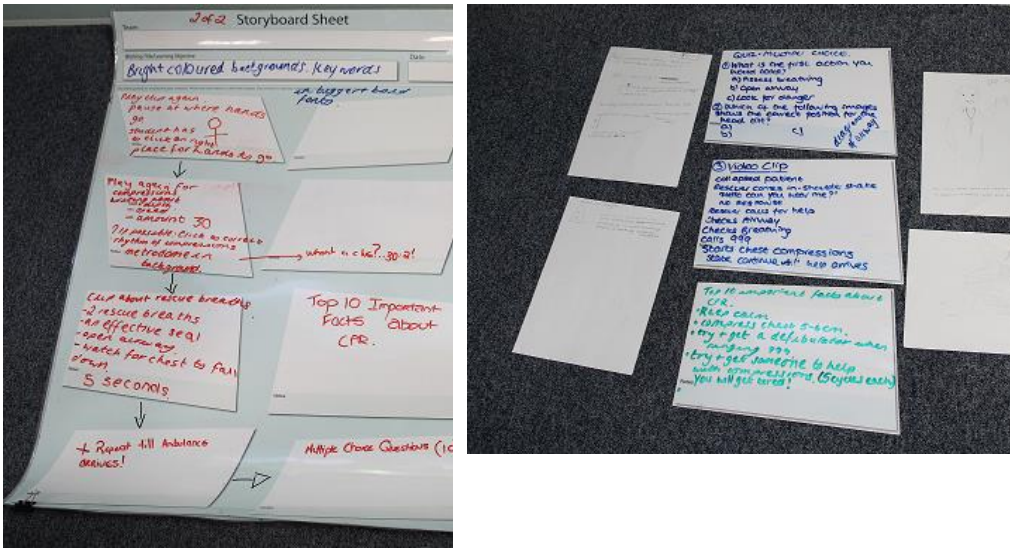


Figure 3-6 Laminated storyboard sheets.
Figure 3-6 displays an illustration of the material used by the groups. The "A0" (on left) and "A3 & A4" on right size laminated storyboard sheet were used by the participants to capture their work.

3.2.1.3 Procedures

The storyboard workshops for the student-designed and tutor-designed group began at 09:00. The student and tutor group workshop were scheduled for different days to reduce the possibility participants may inadvertently meet and discuss their storyboard creation plans and to allow the workshop environment to be returned to its original condition. The schedule for the session can be viewed in Fig. 3-7 and was adhered to on both days, ensuring all participants received the same instructions and resources in the same environment and allocated the same time to work on the storyboard, to minimise bias in the investigation.

Whilst it was important not to stifle creativity some boundaries were necessary for methodological and practical reasons to ensure compatibility between the groups and to ensure that differences could be ascribed to the functioning and pedagogical decisions of the group and not an uncontrolled variable. If a group had no clear parameters in the creation of a storyboard for the design of a learning object, it would be more difficult to draw conclusions on how each group worked and if there were no time constraints this would not reflect the real world position developing educational resources. Clear boundaries regarding the time and resource available were required as without imposing structure to a learning object development the process is less likely to be finished (University of Nottingham, 2010b).

Time	Content	Lead
09:00	Introductions, environment and expectation for the morning. *This session was for brief introductions, to complete consent and travel expense forms and orientate the participants to the Health E-Learning and Media studio and environment where they would be working.*	Researcher
09:15	What is an RLO? *The facilitators for the storyboard workshop were e-learning experts based in the School, supervising the researcher though not undertaking the research.*	Facilitator 1 Facilitator 2
09:30	Information about the content of the RLO. *The researcher made a brief presentation to the participants about basic life support and what material (Resuscitation Council UK adult basic life support guidelines and the Advanced Life Support course manual) was provided for them to work from, during the morning.*	Researcher
09:45	Storyboard creation – group work to commence *Participants commenced work on creating their storyboard on how they believed adult basic life support established knowledge was best represented in an RLO. Participants were advised to use the first 30 minutes of this time to review other learning objects they were aware of or found on the internet and then move (if necessary with a facilitators prompt), to the storyboard creation component of the workshop, taking a break as they wished during the morning.*	Facilitator 1 Facilitator 2
12:45	Next steps *Participants explained their storyboard to the researcher and facilitators and were reminded the researcher would develop their RLO and involve them in this process, to ensure their final design represented their groups view.*	Researcher & Facilitators
12:55	Summary and close.	Researcher

Figure 3-7 Storyboard creation workshop schedule
Figure 3-7 demonstrates the plan for the storyboard workshop schedule, followed for the student-designer and tutor-designer group. It was important to ensure both groups received the same instructions in the same environment from the same individuals, to minimise any potential bias. In the figure, the text in italics below each heading explained each part of the morning workshop.

On arrival participants' completed storyboard workshop consent forms having been sent to them two weeks previously. The research team comprising the researcher and two facilitators made three short presentations explaining the environment they would be working in, reminding participants what an RLO was and of the resuscitation information they could refer to.

Each group then spent approximately 30 minutes reviewing the resuscitation information provided and searching for and reviewing online learning resources about resuscitation. They then commenced (prompted by a supervisor if necessary) the storyboard creation part of the workshop of approximately two hours duration. Towards lunchtime when each group agreed they had made sufficient progress with their storyboard they summarised their work to the researcher and facilitators. This allowed the research team to clarify aspects of the participants' storyboard and gain an overview of how the students and the tutors believed their work should be represented in their respective learning object. After the participants had finished, the researcher photographed the storyboard material created for the development of the learning object. Once this was completed the room and materials, including the computer browser history, were reset to maintain anonymity and prevent the group on the following day inadvertently gaining insight into the previous groups deliberations. The digital data (video recordings and images) were saved onto DVD and once checked to ensure all the material was complete and technically accessible, secured in a locked filing cabinet with the completed consent forms.

The Storyboard Workshop recordings (phase 1) were not formally reviewed or analysed until the student-designed and the tutor-designed learning objects were completed and Learning and Evaluation data (phase 2) had been collected, to avoid any unintended bias from the researcher.

By using a structured approach and reviewing video files for the observations, it is possible to classify the observed behaviour and discussions according to the specific model as the video file can be reviewed on multiple occasions. For consistency, the video recordings were viewed on the same number of occasions to avoid possible overfamiliarity introducing bias favouring one group as Martin and Bateson (2007, p102) highlighted "… the ease with which a film or video tape can be replayed may lead to a temptation to analyse the record repeatedly…". However, Martin and Bateson (ibid) agree using video recording rather than real-time observation to code behaviour can be justified when the material is complex, as with the storyboard workshop.

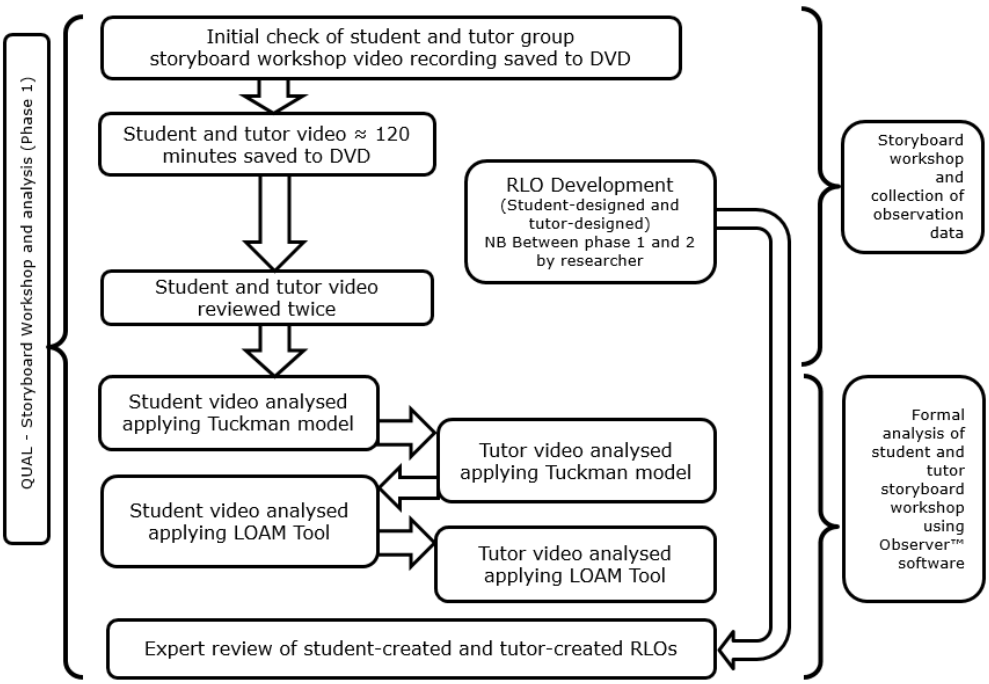


Figure 3-8 Workshop video recordings procedure
Figure 3-8 displays chronologically the steps followed when the video recording of the storyboard creation workshop were saved, reviewed and then formally analysed.

3.2.1.4 Measures

The investigation of how a student and separately a tutor group created a storyboard for the subsequent development of a learning object novice nursing students could use to acquire established knowledge required the identification of suitable models to analyse the video data. The frameworks identified to analyse the video recordings of each groups' storyboard workshop were Tuckman's group development model by Tuckman (1965) and a Learning Objects Attribute Metric (LOAM) Tool by Windle et al, (2007) discussed in Section 3.1.4.

3.2.2 **RLO Development**

The RLO development process followed a structured approach (see Fig. 3-2) developed by Windle & Wharrad (2010) and the student-designed and tutor-designed learning objects developed over a twenty month period in 2012/2013 after the storyboard workshops (see Fig. 3-3). Both learning objects developed by the researcher represented the wishes of each group, confirmed by feedback received from participants on their respective design (see appendix 8.10). Any significant technical knowledge was

provided by learning technologists or those with technical expertise of e-learning development tools and only necessary in the learning object development not design stage.

Once the storyboard workshops were completed, they were transferred into a Microsoft PowerPoint presentation and content developed including audio scripts and sourcing copyright free images or ones that were available for educational purposes under a Creative Commons licence, (Creative Commons, undated). Both groups requested a video of an adult who suffered an out of hospital cardiac arrest to be incorporated in to their final RLO and this reflected the fact that both groups were asked to design a storyboard for a learning object on established resuscitation knowledge. Arrangements with the University Video Production Department enabled a short two-minute video to be made for inclusion in each groups' final resource, the researcher scripted the video and professional actors were engaged for the filming.

The final stage of the RLO development involved the researcher using proprietary e-learning software (Articulate™, New York, NY, USA) to produce the student-designed and tutor-designed RLOs for the Learning and Evaluation (phase 2), though the way student-designers and tutor-designers wished to incorporate the video differed and is discussed in section 5.4.1.2. A peer review of the student designed and tutor-designed RLOs was performed by senior students not involved in the research and their feedback confirmed both resources were suitable and ready to be used in the Learning and Evaluation (phase 2) of the investigation. The student designed RLO 01 can be viewed at http://www.nottingham.ac.uk/~ntzmgt/alan/rlo1/player.html and the tutor designed RLO 02 at http://www.nottingham.ac.uk/~ntzmgt/alan/rlo2/player.html and to retain impartiality, the reviewers were not aware of the designers.

At each stage of the learning object specification (the initial Microsoft PowerPoint presentation summarising each groups storyboard workshop, the video and the RLO peer review) the material was emailed to the group participants for confirmation what was being developed was an accurate representation of what they intended. The replies confirmed the student-designed and tutor-designed learning objects developed were an accurate

representation of their workshop activity (Appendix 8.10). It was essential to ensure participants retained control of what they created whilst not overburdening them, as their participation in the research was voluntary and to minimise the possibility of the researcher inadvertently including material not desired by the participants.

An e-learning expert applied the online LOAM Tool (LOAM, 2014) providing additional data to evaluate the pedagogical decisions made by the designers of each resource. This evaluation involved the e-learning expert reviewing each RLO and recording to what extent pedagogical factors were represented in the final resource. By including this aspect in the investigation, it was possible to ascertain to what extent decisions made during the storyboard workshop were represented in the student-designed and the tutor-designed RLO, with the results reported in section 4.1.4.

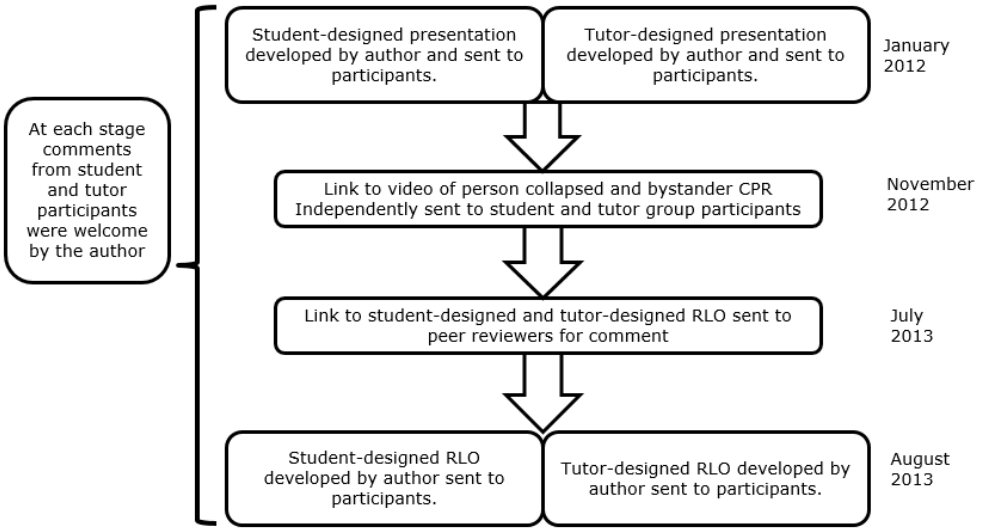


Figure 3-9 RLO Development
Figure 3-9 illustrates the stages of the development and validation processes to ensure what was represented in each groups RLO represented what they initially discussed and designed in the storyboard workshop

The inclusion of a third resource produced by a commercial organisation would have allowed a comparison of the learning and evaluation between the in-house RLOs and an externally produced resource. However, as the primary focus of this research was to determine how students and separately tutors functioned and what pedagogical factors they believed important, in the design of a learning object, this stage would not be visible or accessible to the researcher in a commercially available resource. A further investigation comparing the learning and evaluation of an in-house

designed RLO with a commercially available resource could establish if there were any differences in learning, however without a clear understanding of the design process that may be commercially sensitive, a deeper understanding why one resource confers learning gains would not be possible to establish. As attractive as it initially appears, the use of resources designed and developed by others can be problematic, as educators may not find an appropriate resource for their learners' needs. Because the range of content that can be included in one resource, from being too small and out of context, to so large and unwieldy (Windle & Wharrad, 2010) means further work to better understand these issues is necessary (also see section 1.3.3).

3.2.3 **Learning and Evaluation (Phase 2)**

3.2.3.1 Participants

All 421 students in the September 2013 BSc (Hons) Nursing cohort were contacted from a neutral email account to reduce any perceived coercion, with an explanation of the research project and a hyperlink in the email to either the student-designed or tutor-designed resuscitation RLO. The invitation email was sent to the students immediately prior to the start of their course or provided to them at their pre-course day. Participants were advised the resource could be viewed at any time though participation in the research would only be possible for the initial 72 hours of their studies, as their planned curriculum included a lecture on resuscitation towards the end of their first week. Had data collection continued after attendance at this lecture it would have been possible a knowledge or confidence change may have been a result of the lecture and not solely from viewing the RLO. It was also possible to view the resource without participating in the research project with this action not affecting the students' progress whatsoever.

Randomisation was achieved by associating each email address in the spreadsheet with a random number generated by Microsoft Excel software; those with odd numbers were emailed a link to the student-designed learning object and those with even numbers received the tutor-designed learning object. All participants were asked to view only the learning object they were assigned with 210 receiving a link to the student-designed resource and 211 assigned to the tutor-designed resource, though due to

poor participation this process was repeated with a subsequent cohort of pre-registration nursing student who commenced their studies in January 2014. This did not attract sufficient participants and a third attempt at recruiting pre-registration student at a pre-course day in September 2014, shortly before they commenced their studies attracted additional participants. However, the investigation remained underpowered though discussion between the researcher and supervisors determined participation was sufficient to continue the investigation and is discussed in the limitations (section 6.2).

3.2.3.2 Setting and Equipment

The September 2013 and January 2014 participants could access their RLO either on or off campus as they wished and the September 2014 participants were introduced to this example of e-learning at a pre-course day (see above, section 3.2.3.1) where they could view their allocated RLO and decide whether to participate in the research.

3.2.3.3 Procedures

Students invited to participate were provided with a hyperlink to their randomly assigned student-designed or tutor-designed learning object that would open in a separate internet browser window, with instructions how they could use the resource and if they wished, participate in the research. Participation involved reviewing the invitation to participate information (see Appendix 8.8) and following an additional hyperlink embedded within the learning object to complete a pre-intervention knowledge assessment and for them to rate the confidence in their resuscitation knowledge. The participant then viewed their allocated learning object before they completed a post-intervention knowledge assessment, again rating their confidence in resuscitation knowledge and a short evaluation of the learning object viewed. The university username was only requested to match pre and post intervention data and was anonymised for subsequent analysis.

The student could i) ignore the invitation email ii) view the RLO and decide not to participate in the research iii) withdraw at any time when viewing the RLO or iv) subsequently request their data was withdrawn from the study demonstrating this study followed accepted ethical principles. Only

analysing fully completed pre and post intervention knowledge and confidence scores confirmed only data willingly provided by participants was analysed.

The complete process took 15-20 minutes with participation in the research allowing the individual to review their knowledge and confidence of resuscitation in a non-threatening environment prior to formal instruction later in their studies. The knowledge, confidence and user evaluation survey data was collected through SurveyMonkey™ (https://www.surveymonkey.com/) a proprietary online survey tool on a password protected School account, downloaded to a Microsoft Excel spreadsheet (Microsoft Corporation, Redmond, WA, USA) and analysed using Statistical Package for the Social Science (SPSS®IBM Corp).

3.2.3.4 Measures

To establish if there was any difference in knowledge, confidence in knowledge or user acceptability of a resource between the student-designed and tutor-designed RLO three outcome measures were used; i) pre and post viewing knowledge assessments, ii) pre and post viewing self-rated confidence in knowledge scores and iii) a user evaluation of the resource they accessed. A simple assessment of resuscitation knowledge was developed and asked the respondents to indicate if a statement was true or false. This form of assessment is an established component of Resuscitation Council accredited education such as the Advanced Life Support course (Resuscitation Council 2018).A power calculation was performed to establish how many participants would be required to establish if there was a difference in knowledge of the participants. Assuming a 20% improvement in knowledge from the 15 item knowledge assessment, $p=0.05$, powered at 80%, 95 participants in each group were required to adequately power the investigation and a sample of 190 was considered achievable.

Knowledge

To assess whether there is any change in knowledge resulting from the use of an educational resource valid and reliable measures are required with random allocation to view one resource. In a non-experimental design where there is no random allocation of participants determining which intervention they receive or participants only receive a post-test assessment, it is not possible to conclude which intervention provides the most effective learning (Cohen, Manion & Morrison, 2005; Gray, 2014). A pre-post design for Learning and Evaluation (phase 2) of this research was adopted, with participants randomly allocated to view either the student-designed or the tutor-designed RLO.

Participants' scores were matched through the use of a unique ID and then replaced with a participant number to anonymise the information, so changes in the individual pre and post scores could be calculated. The time between a pre and post-test knowledge assessment can be important to consider in the research design though as this research investigates the potential changes in knowledge and confidence from viewing a student-designed or a tutor-designed learning object, the short time period between the pre and post-test is not relevant. It is not possible to state whether the student-designed or a tutor-designed RLO would be considered the control or experimental intervention, as this work investigated whether different learning object designers influenced the learning achieved by students after viewing a learning object and therefore two tailed tests were applied (Field, 2018).

For a practical skill to be delivered effectively the underpinning knowledge must be first acquired (Mackway-Jones & Walker, 1999) and if a digital learning resource can enhance the acquisition of knowledge, then more time can be allocated to practising the associated skill or to other areas of a curriculum.

The knowledge assessment was piloted with a cohort of year one nursing students at an outlying centre who were not involved in the research project. A list of statements testing the resuscitation knowledge of the cohort in the assessment of an adult who had collapsed and the delivery of basic life support was devised, with the participants indicating whether the statement was true or false. A 10, 15 and 20 item questionnaire was

provided to three separate groups to establish the optimal number of questions without being overly onerous and avoiding any "floor" or "ceiling" effect where there is a clustering of low or high scores (Polit & Beck 2012). The pilot knowledge assessment (see Appendix 8.9) established that a 15-item questionnaire appeared sufficient to establish any learning change from viewing the RLO.

The addition of an "unsure" option created a multiple-choice question paper rather than a dichotomous true/false assessment and according to Polit & Beck (2010) is preferable. This change discouraged participants from guessing (Lesage et al, 2013) and was included in the final version, with the Learning and Evaluation (phase 2) participants more like to provide their honest answer instead of being forced to choose. This approach encouraged honesty in the replies and replicates a real clinical situation where individuals may refer to colleagues if unsure.

Confidence in Knowledge

A simple one to ten ordinal scale was devised for the participant to rate their confidence of resuscitation knowledge, where one represented no confidence and ten representing total confidence in their knowledge. Each participant scored their confidence in knowledge prior to and immediately after viewing their assigned learning object. By asking participants to judge the confidence they had in their knowledge before and after viewing their assigned learning object, it was possible to determine if there was any difference and whether that difference was between pre and post viewing the resource or between the student-designed and tutor-designed learning objects. Possible reasons for any difference are discussed in section 5.2.2.

User Evaluation of the RLO viewed

The participants completed an evaluation of the resource they viewed using a validated evaluation tool (Health E-Learning and Media Team, undated). The tool is brief to encourage completion and asked the user the following questions (see Box 1 below). Questions one to three asked for a response, with an option to type in additional text if desired and question four, a free text option to share comment about the learning object.

Box 1 – list of user evaluation questions

1. If the resource had been helpful to their learning;
   Very helpful, Helpful, Not helpful, Unhelpful.

2. Whether they experienced any problems using the resource;
   Technical, Difficulty of study, Language, Context or cultural, Other.

3. Whether they would recommend the resource to others – Yes, No

4. What they liked and disliked about the resource – free text

An evaluation of any intervention is necessary because if an educational resource demonstrates a positive learning effect it still needs to be accessible and designed in a user-friendly fashion. It was also important an iterative development process was used as even after the proposal and peer review stages additional comments may be incorporated into future versions of the resource (University of Nottingham, 2010b).

3.2.4 **Data Analysis**

Once data collection for both phases had been completed, the video recordings of the student and tutor storyboard workshop groups were viewed on two occasions so the researcher could familiarise himself with the data prior to formal analysis using Observer software – see Fig. 3-8. A significance of $p<0.05$ determined prior to statistical analysis and is widely accepted as common practice in health and educational research to indicate a significant result (Connolly 2007; Campbell & Swinscow, 2009).

3.2.4.1 Storyboard Workshop (Phase 1)

Data from the student–designed and tutor-designed storyboard workshops was obtained by reviewing video recordings of the groups' storyboard workshop and applying the Tuckman model and the LOAM Tool (see Section 3.1.4 for a description of the models) to the observations. To analyse the video recording when the Tuckman model and LOAM Tool was applied to the data, proprietary Observer™ behavioural analysis software was used. The components from each model were coded and saved into the software by the researcher and a screenshot of the view the researcher had when operating the software can be seen in Figure 3-10. The Observer™ software allowed video to be reviewed on screen with standard video playback controls (play, pause, fast-forward, back) and the audio listened to through standard headphones.

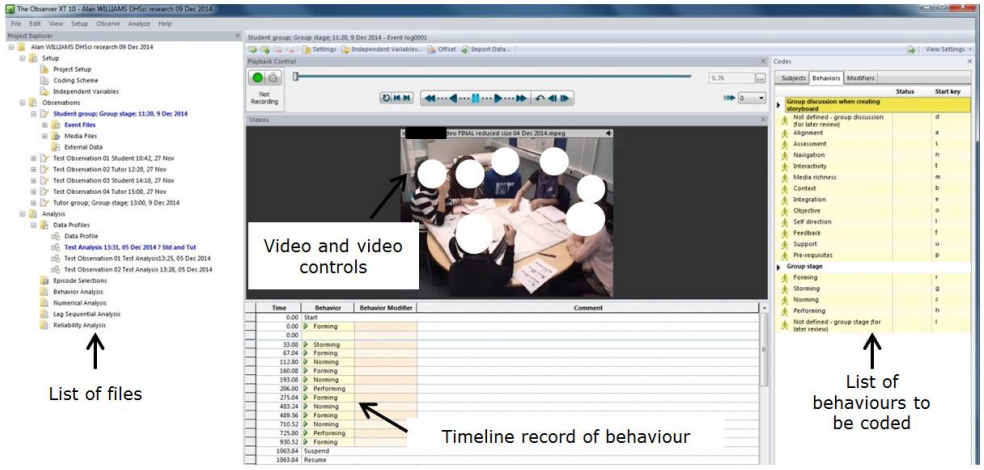


Figure 3-10 Screenshot of Observer XT analysis
Figure 3-10 shows a screenshot of Observer XT analysis in use, On the left of the screen ("List of files") is where the video files are located with the video played in the centre of the screen ("Video and video controls") and audio listened to through earphones. A timeline of the behaviour classified is recorded below the video ("Timeline record of behaviour") and the list of behaviour codes on the right hand side of the screen ("List of behaviours to be coded").

The main data reported in the storyboard workshop was the time in seconds and the percentage of the time each group spent in each Tuckman group stage and how frequently these occurred. The same process was applied to the LOAM Tool pedagogical factors. Due to the small difference in the total time each group spent in the storyboard workshop the data is reported as a percentage of total storyboard workshop time and summarised in tabular format with figures illustrating the student and tutor results (see Tables 4-7 & 4-8). A ranking of the time the groups' discussed each pedagogical factor is included and provided an indication what time student and the tutor group allocated to each pedagogical attribute (see Figure 4-5).

A Pearson Chi-Squared test was used to determine whether the proportion of time spent by the student and the tutor group differed significantly when Tuckman's model was applied, with a two by four table constructed to analyse the data. To determine if there was a significant difference in the time spent on LOAM pedagogical factors between the student and tutor groups, again a chi-squared test was used. Initially the LOAM pedagogical factors data was expected to be analysed using a two by twelve table of the time the student and tutor group spent discussing each factor. However, the descriptive data suggested it was more appropriate to apply the test to a smaller number of categories, due to the absolute time spent by both groups on six pedagogical factors (alignment, media-richness,

context, self-direction, support & pre-requisites) as 100 seconds or less (see Table 4-7) and not amenable to meaningful analysis.

3.2.4.2 Learning and Evaluation (Phase 2)

The learning change comprising knowledge and confidence in participants knowledge results were analysed by comparing the mean score of participants who viewed the student-designed with those who viewed the tutor-designed learning object. The data gathered from a random sample was normally distributed and therefore met the conditions for parametric tests to be applied. As there were two groups (students and tutors) defined as categorical data with mean scores for knowledge and confidence reported on a continuous scale to be analysed, *t-tests* were applied to the data. Though confidence in knowledge was measured on an ordinal scale, a pragmatic view was taken for the analysis of this data using parametric tests as suggested by Norman (2010) and Waltz, Strickland & Lenz (2010). Independent-sample and paired-sample parametric t-tests were used to compare the mean knowledge and confidence in knowledge scores as the t-test is considered to be reasonably robust with data acquired from a random sample (Campbell & Swinscow, 2009; Pallant, 2007).

The independent-samples *t-test* was used to compare mean pre intervention knowledge score of those who viewed the student-designed and tutor-designed RLO and separately to their post intervention knowledge score. The change in mean knowledge scores among the participants was analysed by applying the paired-sample t-test, with the same testing regime applied to analyse the confidence in resuscitation knowledge scores.

Assessing the participants' confidence was important as much earlier work by Wynne et al (1987) demonstrated an individual's self-confidence in their practical resuscitation ability was not associated with actual competence. Though this research did not assess the participants' practical ability, a sufficient grasp of established resuscitation knowledge is necessary for an individual to make an assessment and perform CPR effectively following current guidelines.

A one way between groups analysis of variance (ANOVA) with post-hoc tests were used to determine if there is any difference in the knowledge

and confidence scores in the three cohorts with a parametric Pearson product-moment correlation used to determine the strength and significance between knowledge and confidence in knowledge scores.

3.2.5 **Validity and Reliability**

The concept of research validity and reliability includes many aspects and can be attended to by researchers in different ways, though it is a fallacy to believe every investigation will be completely valid and reliable (Cohen, Manion & Morrison, 2005). Moreover, the lack of a theoretical stance in educational research was identified by Bulfin, Henderson & Johnson (2013, p344) in their survey of education, technology and media investigators, and they suggested there is a need to enhance the "theoretical rigour of academic work in this area" and for researchers to "…be more self-reflexive and self-critical.". To enhance validity researchers must strive to ensure it is clear what is being investigated and a greater reliability in research can be achieved when the methods applied return a similar result when repeated. This investigation's methods strived to achieve a rigorous credible approach to enhance its reliability and validity.

Sandelowski (1986) suggests the validity and reliability of qualitative research can be established by ensuring the issues investigated are recognisable to participants' and readers of the work, the project can be applied to other environments and the methodology is clear for others to follow. In a later article Sandelowski (1993) discussed the tensions between quantitative and qualitative work was discussed, arguing a reductionist approach to ensuring validity and reliability is detrimental to establishing the truthfulness of qualitative work. The debate continues to the present day where Noble & Smith (2015) suggested multiple realities may exist and a clear audit trail, the applicability of the work and reflexivity by the researcher will enhance the credibility of an investigation. This investigation meets these conditions as the design and deployment of learning objects and technology-based education is recognisable to academics and students, and the acquisition of established knowledge using learning object applicable to all disciplines and other areas such as patient information resources or work place education.

3.2.5.1 Storyboard Workshop validity and reliability

This investigation how student-designers and tutor-designers of learning objects worked as a group and what pedagogical factors they discussed, was based on the author's observation working from established criteria, with the content validity of the Tuckman stages of group development model already established (Miller, 2003). Dianne Miller developed a questionnaire, based on exploratory work where the four Tuckman stages were associated with 48 items, generated following an established methodology (Hinkin, 1995), to assess how groups of three to five students over a four week period worked. She also highlighted how Bruce Tuckman's original research was based on groups that met for varying periods of time, from minutes to months and that no requirement for groups to meet for a specified time had been identified.

The LOAM Tool is based on sound a theoretical foundation of IMS learning Design and enabled the researcher to identify and classify pedagogical factors of established learning objects (IMS Global Learning Consortium 2003; Wikipedia 2013). The strong theoretical foundations of the LOAM Tool lends credence to it use in the investigation as the pedagogical factors are recognisable to students and tutors.

In order to assess the reliability of the video analysis an independent experienced e-learning researcher was recruited to view two sections of video and apply the Tuckman and LOAM Tool descriptors to the data. Each section was five minutes duration with the second (25 centile) and fourth (75 centile) quarter identified as the starting point, as each groups' workshop time was slightly different. Whilst viewing the video the independent e-learning expert recorded their interpretation of the Tuckman's group stage and LOAM Tool pedagogical factor discussed, for every ten-second section of the five-minute video and their interpretation was compared to the researcher observations (see Section 4.1.5).

There are a number of methods that can be used to determine interrater reliability including 1) the percentage agreement between individuals and 2) the calculation of Cohen's kappa (McHugh, 2012; Polit & Beck, 2012). Adopting a simple percentage agreement approach raised the possibility of agreement because of chance and potentially overestimated the agreement

between raters, whereas Cohen's kappa tries to account for this, with a score of 0 representing no agreement and 1 total agreement between observers. According to Polit and Yang (2016) the use of kappa elicits much debate despite its wide use in health science research and Everitt & Palmer (2005) highlight because of how scores are distributed and on the number of categories, kappa values between different studies are not necessarily equivalent. Indeed, there are also different estimations of an acceptable kappa ranging from 0.21 reported by Anthony (1999) to 0.5 by Peat (2001).

Polit & Beck (2012) also explain how the intra class correlation coefficient (ICC) can be used to determine the reliability of inter-raters interpretations when applied to scales though the inclusion of ICC alone does not usually determine the accuracy of an instrument due to the test underestimating measurements calculated (Peat, 2001). In later work Polit & Yang (2016) report David Streiner, Geoffrey Norman and David Cairney suggestion to avoid kappa or a weighted kappa and use ICC instead, unless a simple 2x2 table is available, demonstrating the complexity of determining reliability in research (Streiner, Norman & Cairney, 2015).

3.2.5.2 Learning and Evaluation validity and reliability

The learning and evaluation (phase 2) data was based on a quantitative evaluation of participants' pre and post intervention resuscitation knowledge and confidence in their knowledge and on their evaluation of the learning object they viewed. The knowledge assessment was based on one used for the Advanced Life Support course multiple choice question paper (Perkins, Fullerton, Davis-Gomez et al, 2010; Resuscitation Council, 2018), focusing on the initial assessment of a collapsed adult and cardiopulmonary resuscitation interventions and was piloted with nursing students not involved in the investigation to established face and content validity (see Appendix 8.9). The reliability of the knowledge assessment was established by using the same questions in the pre and post knowledge assessment, though in a different order to reduce the potential of familiarity influencing the participant's response and by determining *a priori* the statistical test to be applied to the data. The evaluation data from the participants was reported as provided, with all comments included for analysis (see section 4.2.6).

3.3 Summary

Undertaking this research using a grounded theory approach allows the investigation of and understanding how the storyboards were created as part of the design of learning objects used to acquire established knowledge. This research adopted modified grounded theory with an exploratory sequential mixed methodology participatory design approach and provided a rich qualitative and quantitative data set as suggested by Östlund, Kidd, Wengström & Rowa-Dewar (2011) to understand how learning object are designed by students and by tutors used by novice students to acquire established knowledge and if there are differenes that can be exploited to enhance novice students' learning.

4 Results

The results of this research are presented in two sections. Section 4.1 reports the Storyboard Workshop (phase 1) data after applying the Tuckman stages of group development model and the Learning Object Attribute Metric (LOAM) Tool used to identify pedagogical factors discussed by the participants, followed by an expert review of the student-designed and tutor-designed RLO. Section 4.2 reports the Learning and Evaluation (phase 2) data where changes in knowledge and confidence in knowledge when participants viewed their randomly assigned student-designed or tutor-designed learning object and the participants evaluation of the resource viewed. Each section will commence with an introduction, description of the sample, the research question and results of investigations from the planned analysis, with tabular data and figures included to support the narrative explaining the results.

4.1 Storyboard Workshop (Phase 1)

The storyboard workshop investigated how students and separately tutors function as a group and what pedagogical factors they discuss when they created a storyboard for the design of a learning object novice nursing students can use to acquire established resuscitation knowledge.

4.1.1 Sample

The characteristics of the student and tutor participants can be seen in Table 4-1. The student participants were predominately from the adult field in two centres and all tutor participants were based in the adult field from four centres across the Division of Nursing. Recruiting a purposive sample of participants is appropriate for this research as it closely replicates how RLOs are designed and individuals with a particular interest in creating RLOs are likely to volunteer to participate in a project.

Table 4-1 Storyboard workshop participants.

Field	Students	Tutors
Adult	5	6
Child	1	0
Mental Health	1	0

4.1.2 **Results of Tuckman Group Development Stages (RQ1a)**

The descriptive and inferential statistics summarising how long the student and the tutor group spend in each Tuckman group development stage can be viewed in Table 4-2.

The visualisation in Figure 4-2 is a pictorial representation on a timeline displaying what stage, for how long and the sequence of stages the student and tutor group followed during their storyboard creation process. The longer period spent performing can be seen in the student group visualisation whereas a more 'staccato' progression, repeated on a number of occasions during the tutor storyboard workshop is visible and discussed in section 5.3.2. he tutor group appeared to spend more time forming, storming and norming than the students whilst the student group spent longer performing. A Pearson 2x4 Chi squared test for independence confirmed a significant difference (X^2 (1) = 27.04, *p=.000*) between the time the student designers and tutor designers groups spent in each stage, as a percentage of their respective overall storyboard workshop. Subsequent analysis comparing each stage with all other stage times combined identified tutors spent a significantly longer time forming X^2 (1) = 7.77, *p=.005* and storming X^2 (1)=8.98, *p=.003* though not norming X^2 (1)=1.02, *p=.313.* The student designers spent significantly longer performing than the tutor group X^2 (1) = 23.02, *p=.000*. A comparison of the time the student and tutor group spent in the four stages is represented in Figure 4-1.

Table 4-2 Tuckman group development stages

Student			Group stages	Tutor			
Median & IQR (secs) and *occasions in square parenthesis*	**seconds**	**% of group storyboard creation time**		**% of group storyboard creation time**	**seconds**	**Median & IQR (secs) and *occasions in square parenthesis***	**Difference. Seconds & %**
46s (27-127s) *[15]*	1336	22.9%	Forming	41.3%	2745	94s (45-173s) *[21]*	1409s or 18.4% (to Tut.) ***Significant p=.005***
27s (24-31s) *[2]*	54	0.9%	Storming	10.5%	695	65s (37-86s) *[9]*	641s or 9.6% (to Tut.) ***Significant p=.003***
13s (9-22s) *[16]*	771	13.2%	Norming	17.6%	1167	27s (22-277s) *[22]*	396s or 4.4% (to Tut.) ***Not significant p=.313***
146s (69-692s) *[8]*	3621	62.0%	Performing	28.0%	1862	76s (35-103s) *[17]*	1759s or 34.0% (to Std.) ***Significant p=.000***
	56	1.0%	not defined	2.6%	175		
	5838	100.0%	Totals	100.0%	6644		

Note. In tables and figures student data is displayed in blue and tutor data is displayed in pink

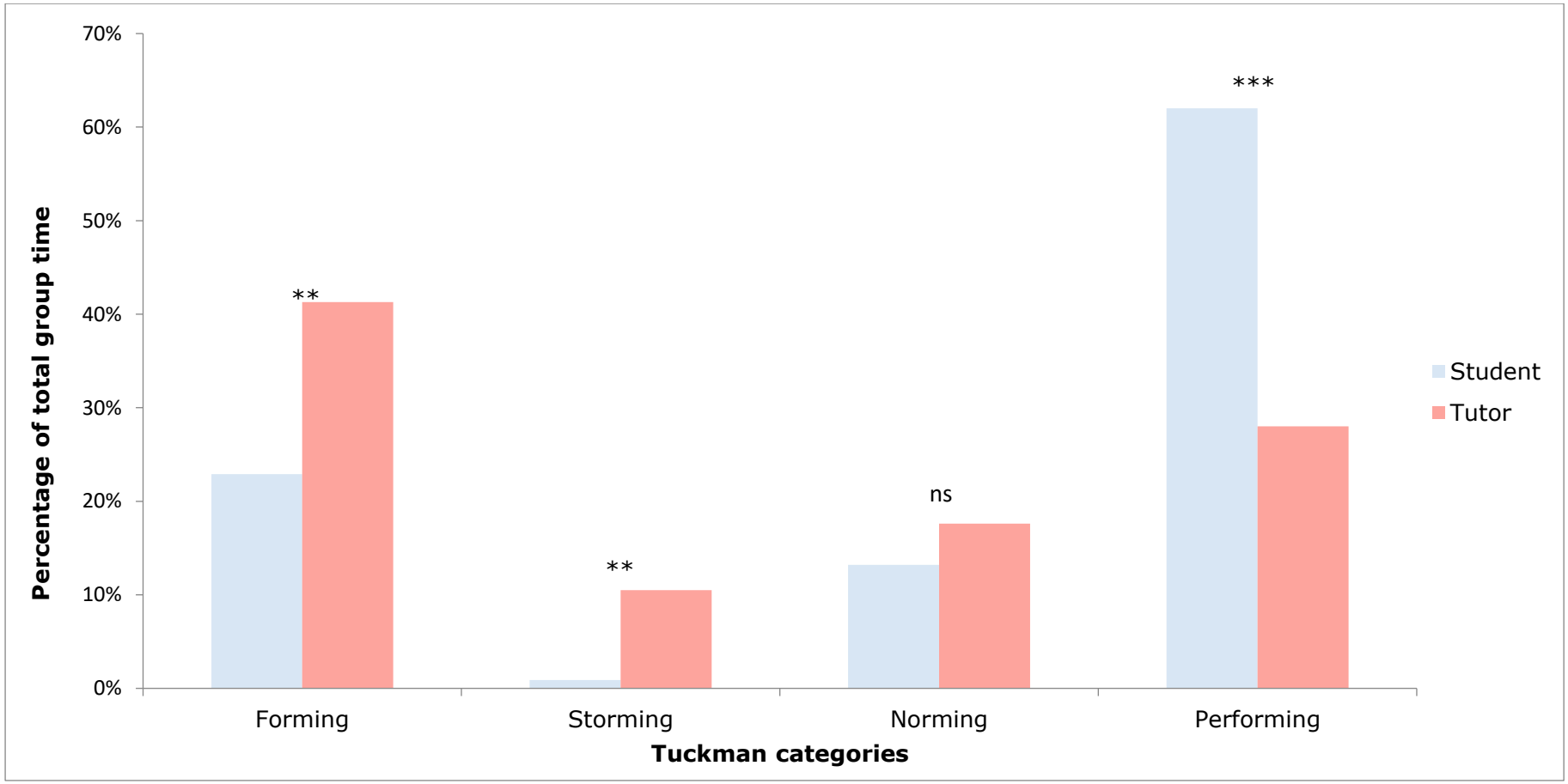


Figure 4-1 Comparison of Tuckman group development stages.
Figure 4-1 displays the comparison of the time student (in blue) and tutor (in pink) spent in each Tuckman stages of group development, with the asterisk indicating significance (** *p=<0.01*, *** *p=<0.001*)

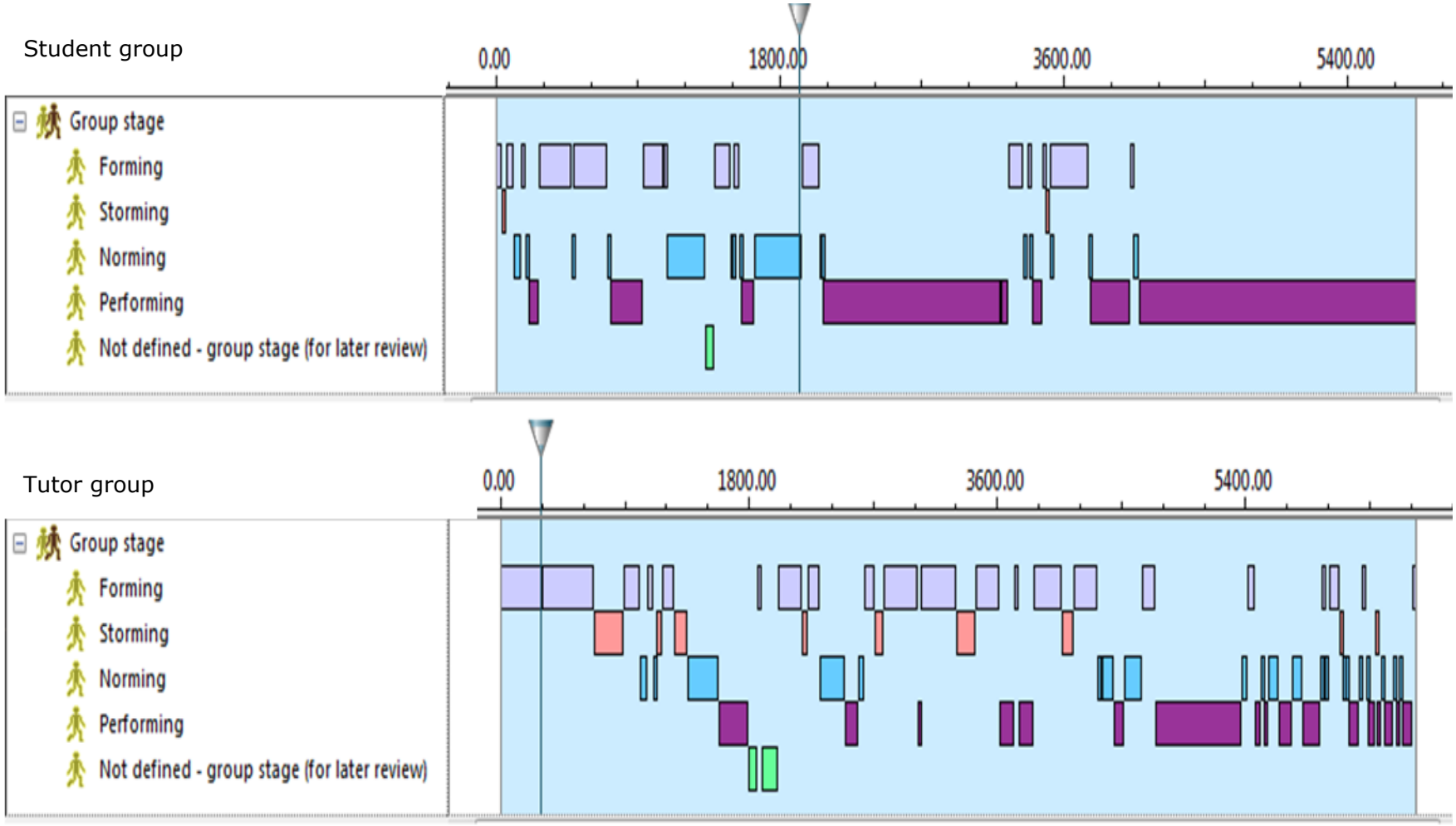


Figure 4-2 Visualisation of Tuckman group development stages
Figure 4-2 shows a visualisation from Observer XT software of where, when and for how long the student and the tutor group spend in each stage from Tuckman's model. The colours are assigned by the software and are only to differentiate the recorded behaviours.

The following tables 4-3 to 4-6 indicate what stages followed each from Tuckman's model and displays descriptive data comparing the student and tutor group, with the inclusion of a 'not defined' and 'end of workshop' stage for completeness. Descriptive data showing what stage follows forming, storming, norming and performing by the student and tutor group is then displayed in Tables 4-3 to 4-6, with clear descriptive differences complementing the group stage visualisation in Figure 4-2 (above).
In total student underwent 38 transitions between stages and the tutors 64 that confirmed the more fragmented progress tutors made during their workshop and visible in Figure 4-2. In particular, there was a noticeable difference in the storming and performing stages, where the students less frequently entered these stages, spent much less time storming and much longer performing.

Table 4-3 Summary of stages following Forming

Group Stage FORMING	**Student group Number of occasions**	**Tutor group Number of occasions**
Forming then Storming	2	7
Forming then Norming	12	6
Forming then Performing	0	5
Forming to not defined	1	0
Forming to end of workshop	0	1
Total	15	19

Table 4-4 Summary of stages following Storming

Group Stage STORMING	**Student group Number of occasions**	**Tutor group Number of occasions**
Storming then Forming	1	6
Storming then Norming	1	2
Storming then Performing	0	1
Total	2	9

Table 4-5 Summary of stages following Norming

Group Stage NORMING	**Student group Number of occasions**	**Tutor group Number of occasions**
Norming then Forming	6	7
Norming then Storming	0	1
Norming then Performing	7	11
Norming to not defined	1	0
Total	14	19

Table 4-6 Summary of stages following Performing

Group Stage PERFORMING	Student group Number of occasions	Tutor group Number of occasions
Performing then Forming	5	4
Performing then Storming	0	1
Performing then Norming	1	11
Performing to not defined	0	1
Performing to end of workshop	1	0
Total	7	17

4.1.3 Results of LOAM Tool Pedagogical Factors (RQ1b)

The descriptive and inferential statistics summarising how long the student and the tutor group spent discussing LOAM Tool pedagogical factors can be found in Table 4-7. The student group appear to spend more time discussing pedagogical factors that contribute to the Activity and Roles sub-heading, with the tutor group spending more time focusing on discussing pedagogical factors contributing to the Environment sub-heading. However when a Pearson 2x3 Chi-squared test of independence was applied to the data there is no significant difference between the student group and tutor group in the overall time allotted to the sub-headings, as a percentage of each groups storyboard workshop time (X^2 (1)=2.43, $p=.297$).

Further inspection of the time spent by students and by tutors on the pedagogical factors that contribute to each sub-headings was undertaken. A Pearson 2x2 Chi squared test was applied to the data and confirmed no significant difference in the Activity versus non Activity pedagogical factors X^2 (1) =1.24, $p=.266$, Environment versus non Environment pedagogical factors X^2 (1) = 2.43, $p=.119$ and Roles versus non Roles pedagogical factors X^2 (1) = 0.66, $p=.416$ sub-headings. When a Pearson 2x2 Chi squared test was applied to the six individual pedagogical factors amenable to analysis (assessment, navigation, interactivity, integration, objective and feedback), students spent significantly longer discussing navigation ($p=.03$) and tutors spend significantly longer discussing objective ($p=.02$). A comparison between the student and tutor discussions of each pedagogical factor is presented in Figure 4-3 with a visualisation of these factors on a time line in Figure 4-4.

Table 4-7 LOAM Tool Factors discussion data

Student			Group Discussion Major headings and pedagogical attributes		Tutor				
Median & IQR (seconds)	Seconds discussing each factor	% of storyboard creation time			% of storyboard creation time	Seconds discussing each factor	Median, IQR (seconds)	Absolute difference in time, as percentage of storyboard creation time and *p value.*	Positional difference
n/a	0	0.0%	ACTIVITY	Alignment	0.0%	0	n/a	n/a ***no test applied***	**n/a**
22, 22-271	564	9.7%		Assessment	9.9%	654	60, 22-75	90s. or 0.2% to tutor ***ns***	**±1**
39, 36-72	400	6.8%		Navigation	0.6%	40	5, 3-12	360s. or 6.2% to student ***p=.03***	**±1**
38, 31-75	655	11.2%		Interactivity	10.4%	686	31, 13-44	31s. or 0.8% to tutor ***ns***	**±1**
	1619	**27.7%**	**ACTIVITY Total**		**20.9%**	**1380**		239s. or 6.8% to student ***ns***	
54, 54-54	54	0.9%	ENVIRON.	Media-richness	0.3%	23	23, 23-23	31s. or 0.6% to student ***no test applied***	**±1**
14, 14-14	14	0.2%		Context	0.3%	23	23, 23-23	9s. or 0.1% to tutor ***no test applied***	**±1**
22,15-37	1259	21.5%		Integration	16.0%	1062	15, 7-28	197s. or 5.5% to student ***ns***	**=**
60, 25-122	1907	32.6%		Objective	49.3%	3262	43, 24-86	1355s. or 16.7% to tutor ***p=.02***	**=**
	3234	**55.2%**	**ENVIRONMENT Total**		**65.9%**	**4370**		1136s. or10.7% to tutor ***ns***	
n/a	0	0.0%	ROLES	Self-direction	1.3%	87	87, 87-87	87s. or 1.3% to tutor ***no test applied***	**±5**
40, 19-68	761	13.0%		Feedback	9.1%	605	20, 13-38	156s. or 3.9% to student ***ns***	**±2**
47, 44-49	93	1.6%		Support	0.0%	0	n/a	93s. or 1.6% to student ***no test applied***	**±4**
n/a	0	0.0%		Pre-requisites	0.5%	34	n/a	34s. or 0.5% to tutor ***no test applied***	**±2**
	854	**14.6%**	**ROLES Total**		**10.9%**	**726**		128s. or 3.7% to student ***ns***	
	136	2.3%	n/a	Not defined	2.2%	144			
	5843	100.0%	Total		100.0%	6620			

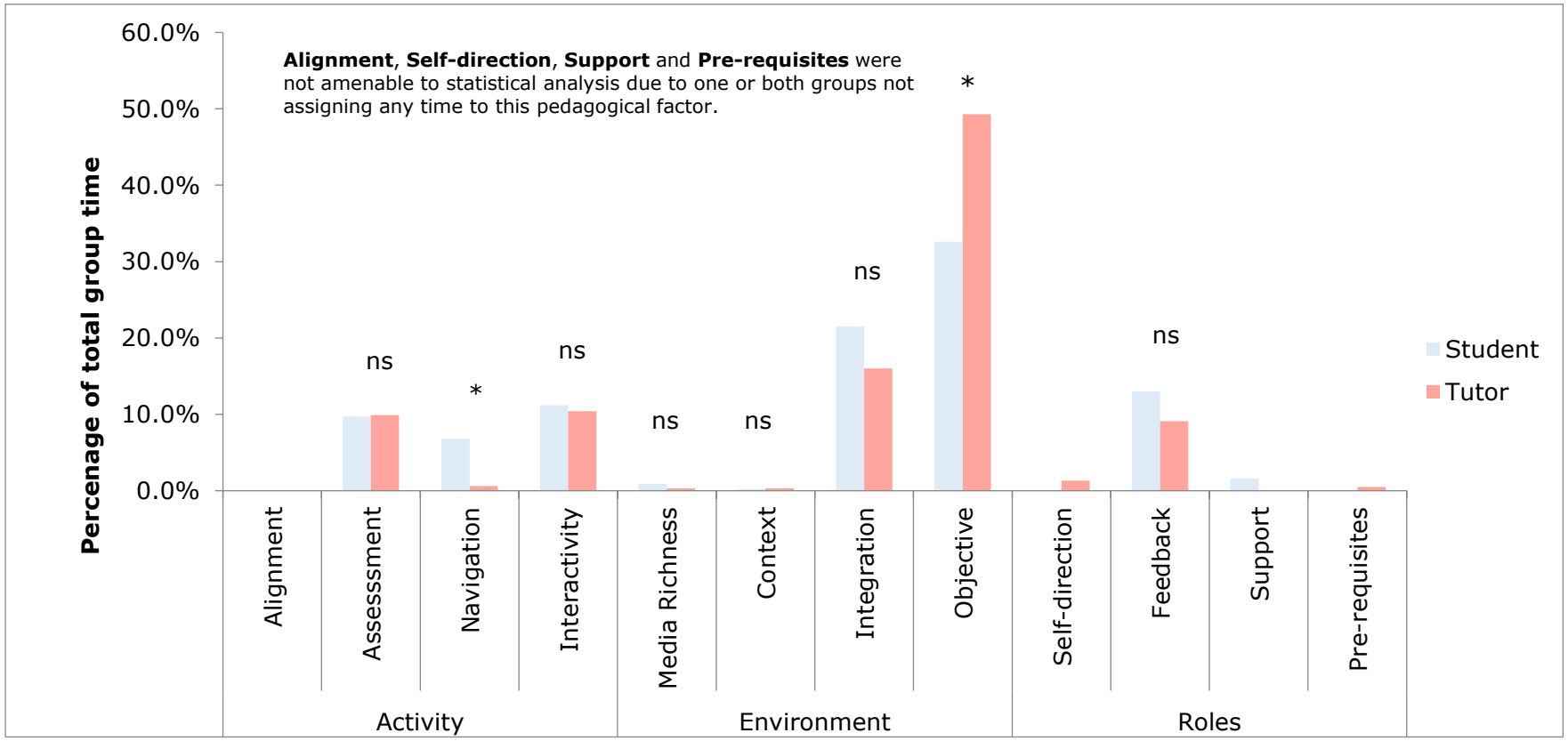


Figure 4-3 Comparison of LOAM Tool Factors
Figure 4-3 displays a comparison of the time the student and tutor groups' spent discussing LOAM Tool pedagogical factors. *$p<0.05$

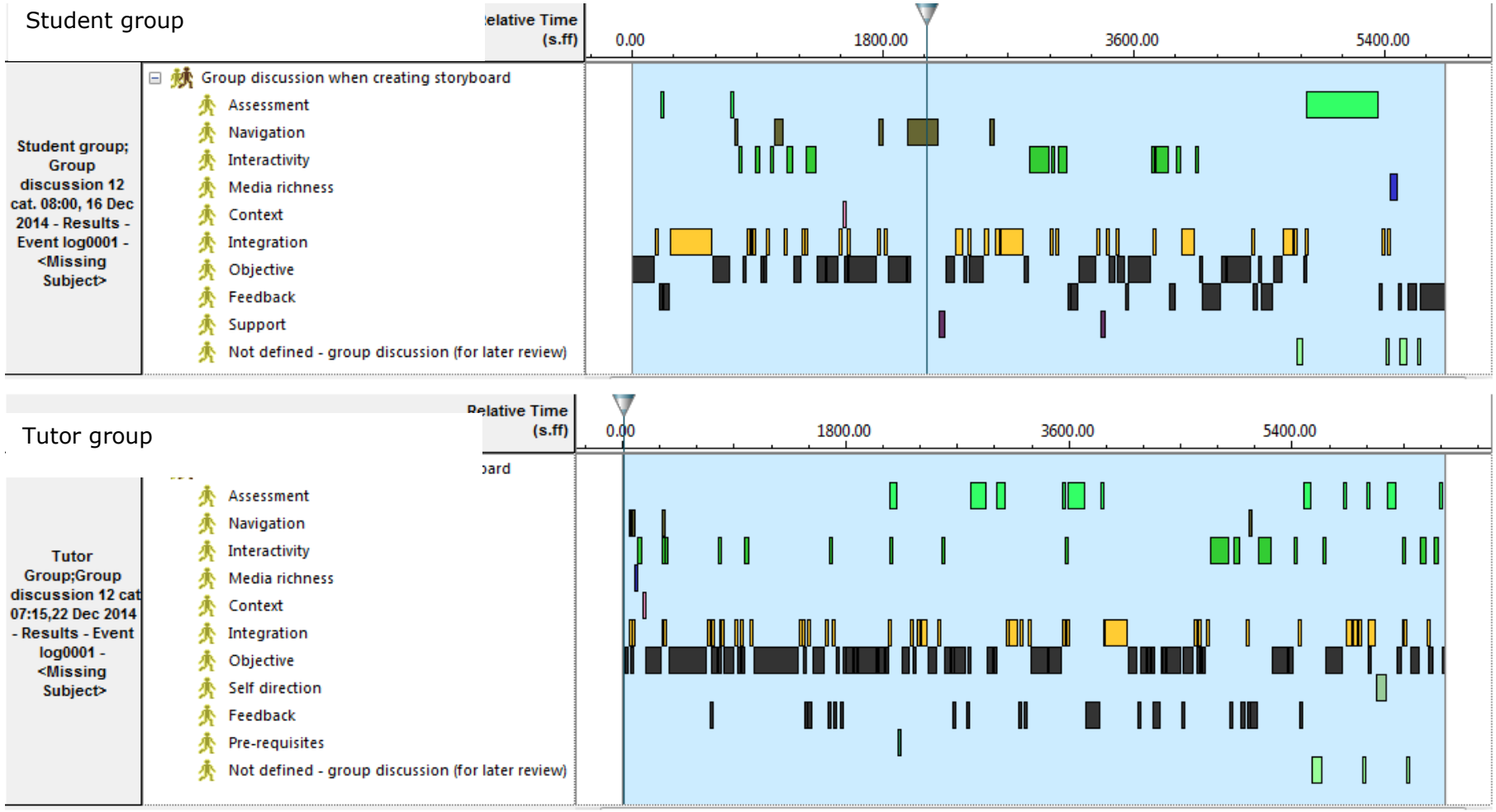


Figure 4-4 Visualisation of LOAM Tool Factors discussions
Figure 4-4 shows a visualisation from Observer XT software of where, when and for how long the student and the tutor group spend discussing each pedagogical factor identified from applying the LOAM Tool. Where no time was assigned to a pedagogical factor it is not listed.

The twelve pedagogical factors presented in Table 4-8 are ranked by the most difference in percentage in time spent by each group, with their relative position, absolute values and percentage time spent by each group also noted. This information is also presented in Figure 4-5 with the pedagogical factors position ranked by the time each groups spent discussing the particular factor. The application of a Spearman rho demonstrated a large significant correlation between the student and tutor group discussions of the twelve pedagogical factors $r = .815, n=24, p = .001$.

The largest differences in ranking was seen in support and self-direction which may relate to the level of control a learner has to construct their own learning journey. However though there is a difference of four and five places respectively (see Fig 4-5) the actual time allocated by each group was minimal (see Table 4-8) with students not considering self-direction and tutors not discussing support in their design. This could indicate a difference in the way students and tutors approach these pedagogical factors discussed in section 5.4.1.1.

A further seven pedagogical factors (feedback, interactivity, assessment, navigation, media-richness, context, pre-requisites) were ranked with-in two positions of each other though only it was only with navigation characteristics that this ranking difference was seen to be significant. The students spent 400 seconds discussing navigation where as the tutors only spent 40 seconds ($p=0.03$).

Three pedagogical factors were ranked exactly the same with the objective first, integration second and alignment last, though the only significant difference was tutors spent significantly longer discussing the objective. Students spent 1907 seconds discussing the objective where as the tutors spent 3262 seconds ($p=0.02$).

Table 4-8 LOAM Tool Pedagogical Factors and RLO expert review

LOAM Pedagogical Factor		Author's interpretation of Storyboard Workshop				E-learning expert rating of reusability of using online LOAM Tool	
Sub-heading	Pedagogical factor (If no p value then no test applied.)	Difference in time spent, ranked by most to least time difference.	Absolute (std., tut.) & positions difference	Storyboard Workshop time.		1=low reuse, 5=high reuse	
				Student group	Tutor group	Student group	Tutor group
Environment	Objective *(p=.02)*	16.7% to tut.	(1,1) & =	32.6%	49.3%	2	1
Activity	Navigation *(p=.03)*	6.2% to std.	(6,7) & ±1	6.8%	0.6%	2	2
Environment	Integration *(ns)*	5.5% to std.	(2,2) & =	21.5%	16.0%	4	3
Roles	Feedback *(ns)*	3.9% to std.	(3,5) & ±2	13.0%	9.1%	5	4
Activity	Interactivity *(ns)*	0.8% to tut.	(4,3) & ±1	11.2%	10.4%	1	3
Environment	Media richness	0.6% to std.	(8,9) & ±1	0.9%	0.3%	3	3
Activity	Assessment *(ns)*	0.2% to tut.	(5,4) & ±1	9.7%	9.9%	1	1
Environment	Context	0.1% to tut.	(9,10) & ±1	0.2%	0.3%	5	4
Roles	Self-direction	1.3% to tut.	(11,6) & ±5	0%	1.3%	1	1
Roles	Pre-requisites	0.5% to tut.	(10,8) & ±2	0%	0.5%	1	3
Roles	Support	1.6% to std.	(7,11) & ±4	1.6%	0.0%	3	3
Activity	Alignment	n/a	(12,12) & =	0.0%	0.0%	1	1

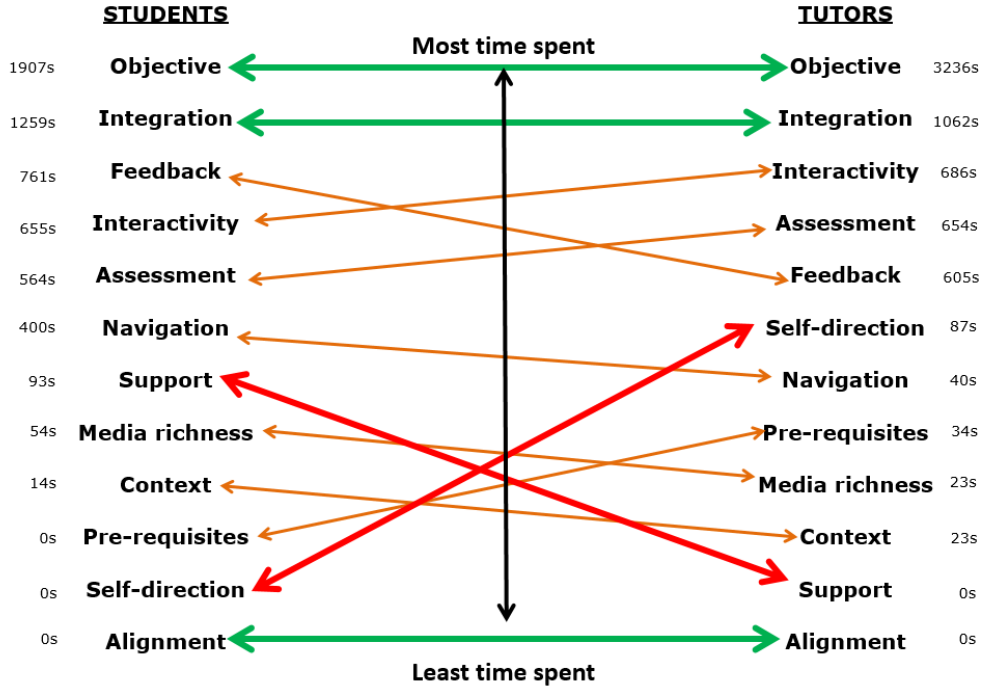


Figure 4-5 LOAM Tool Factors ranking, student and tutor groups
Figure 4-5 shows the time spent by the student and tutor groups discussing pedagogical factors ranked by most to least time. Three pedagogical factors are ranked the same indicated by the green arrow and two are more than three or more positions different identified by the red arrow. The other pedagogical factors discussed are with-in one or two position of the other group ranking. It should be noted the only significant difference in time between the groups is with the objective both ranked first and navigation pedagogical factor ranked sixth (students) and seventh (tutors).

4.1.4 Expert Review of Student and Tutor RLO

The student designed and the tutor designed RLOs were viewed by an expert in e-learning who applied an online version of the LOAM tool to each resource (LOAM, 2014). This enabled the reviewer to score the extent to which each of the pedagogical characteristics within the tool featured in the product, by scoring it on a Likert scale from 1 where it featured fairly little to 5 where it was represented in a richer, more complex way – see Figure 4-6. The assessment of pedagogical factors highlighted the student-designed and tutor-designed learning object appear similar when viewed as a "radar graph" (Figure 4-6), with this analysis compared to the storyboard workshop LOAM Tool pedagogical factors discussed by the student and tutor groups (Table 4-8).

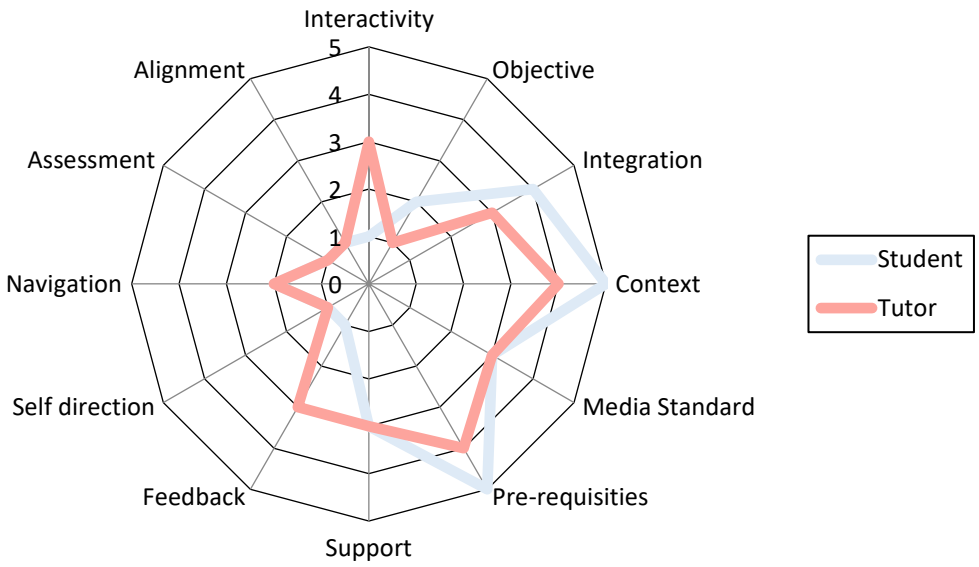


Figure 4-6 Expert review using LOAM Tool of RLO Pedagogical Factors
Figure 4-6 shows the results of the expert observation, which was undertaken blindly and indicates similarities between the student-designed nad tutor-designed learning object, in many of the characteristics such as alignment and media. This probably represents the nature of the resources themselves and the instructions given to each group. However, some subtle differences were apparent, for example a richer level of interactivity was visible in the tutor generated resource, whereas the student derived resource appeared to concentrate slightly more on providing the context to the resource and also on the level of pre-requisite knowledge that the learners had.

4.1.5 Reliability Measures of Tuckman and LOAM Tool

Efforts to confirm the reliability of the coding of the Tuckman and LOAM Tool descriptors (Appendix 8.11 and 8.12) were made with an independent researcher recruited to validate the researcher's observations. However, the results were inconclusive and though viewing the storyboard workshop video could provide reassurance to others, was not permitted by the research ethical approval.

There was a low reliability in the observations between researcher (rater A) and the independent e-learning researcher (rater B) interpretations of the Tuckman model and LOAM Tool sections of videos reviewed (see Appendix 8.13). The results indicate absolute concordance between the raters in the Tuckman and LOAM Tool of only 16.7% and 36.7% respectively (indicated in green in Table 4-9) when measured by percentage agreement (McHugh,

2012; Polit & Beck, 2012). However when near concordance was considered (green and orange in Table 4-9) where both raters indicated only one stage difference in Tuckman model or when pedagogical factors from the same sub-heading were indicated by both raters, concordance improved to 50% and 42.5% respectively, and is discussed in the Limitations (Section 6.2.2). The calculation of Cohen's kappa from the same data resulted in fair agreement (0.21-0.4) in the raters Tuckman observations when there was near concordance and with absolute and near concordance with the LOAM Tool data, when assessed with Landis and Kock's (1977) scale (see Table 4-9). The lack of agreement between the raters when absolute concordance with the Tuckman observations was apparent with these results discussed in the limitations (section 6.4.2).

Table 4-9 Cohen's kappa for Tuckman and LOAM reliability

Model	Description	Cohen's Kappa[6]
Tuckman	Absolute agreement between rater A and rater B. Both ascribed the same Tuckman stage to the observation.	-0.1 (*p=0.018)*
	Near agreement between rater A and rater B. Both ascribed the same or only one place difference Tuckman stage to the observation. When the stage was recorded as Not Defined absolute concordance was required between both raters.	0.3 *(p=0.000)*
LOAM	Absolute agreement between rater A and rater B. Both ascribed the same LOAM Tool Pedagogical factor to the observation.	0.23 *(p=0.000)*
	Near agreement between rater A and rater B. Both ascribed the same LOAM Tool pedagogical factor or both raters ascribed the same sub-heading (Activity, Environment or Roles) to the observation. When the stage was recorded as Not Defined absolute concordance was required between both raters.	0.29 *(p=0.000)*

[6] Poor agreement 0.0—0.20, fair agreement 0.21-0.40, moderate agreement 0.41-0.60, substantial agreement, 0.61-0.80, almost perfect agreement 0.81-1.00 (Anthony, 1999).

Table 4-10 Reliability of Tuckman and LOAM Tool results

	Rater	Tuckman				LOAM			
		A	B	A	B	A	B	A	B
	Video	Student		Tutor		Student		Tutor	
	Secs.	1=F;2=S;3=N;4=P 5=not defined				2=assessment; 3=navigation; 4=interactivity; 5=media richness; 6=content; 7=integration; 8=objective; 10=feedback;13=not def.			
Video Clip 1 - 00:27:40 to 00:32:40 (hh:mm:ss) [1660-1960 seconds on Observer XT10 file]	0-10	1	1	4	3	8	13	10	4
	11-20	1	4	4	3	8	13	4	4
	21-30	1	1	4	3	8	7	4	4
	31-40	3	1	4	1	7	7	4	4
	41-50	3	1	4	1	7	7	7	4
	51-60	1	2	4	1	6	6	10	10
	61-70	1	2	4	4	8	6	10	10
	71-80	1	2	4	4	8	8	8	8
	81-90	3	4	4	4	8	8	8	8
	91-100	4	4	4	3	7	7	8	8
	101-110	4	4	4	1	8	7	8	8
	111-120	4	1	4	1	8	8	10	10
	121-130	4	1	4	1	8	8	8	8
	131-140	4	1	4	2	8	13	8	8
	141-150	4	1	5	2	8	13	8	8
	151-160	4	1	5	1	8	13	8	13
	161-170	4	1	5	1	8	13	8	13
	171-180	4	1	5	3	8	13	8	13
	181-190	3	3	5	1	8	13	8	13
	191-200	3	4	5	4	8	8	8	13
	201-210	3	4	1	4	8	8	8	8
	211-220	3	4	1	4	8	8	8	8
	221-230	3	4	1	3	8	8	8	8
	231-240	3	4	1	3	8	8	8	8
	241-250	3	4	5	4	8	8	8	8
	251-260	3	3	5	4	8	13	8	13
	261-270	3	3	5	4	8	13	8	13
	271-280	3	3	5	3	8	7	8	13
	281-290	3	4	5	3	8	7	8	13
	291-300	3	4	5	3	8	7	8	13
Video Clip 2 - 01:23:00 to 01:28:00 (hh:mm:ss) [4980-5280 seconds on Observer XT10 file]	0-10	4	4	4	3	8	8	4	7
	11-20	4	4	4	3	8	8	10	7
	21-30	4	3	4	3	8	8	10	8
	31-40	4	3	4	3	8	8	10	8
	41-50	4	3	4	3	8	8	10	8
	51-60	4	4	4	4	8	7	7	7
	61-70	4	3	4	4	8	7	7	7
	71-80	4	3	4	4	7	7	10	4
	81-90	4	3	4	3	7	7	3	4
	91-100	4	3	4	3	10	7	10	5
	101-110	4	3	4	3	10	7	10	5
	111-120	4	3	4	1	10	7	10	5
	121-130	4	1	4	1	10	13	10	5
	131-140	4	4	4	3	8	13	10	5
	141-150	4	4	4	3	10	13	10	5
	151-160	4	4	4	3	10	13	10	5
	161-170	4	4	4	1	10	13	4	5
	171-180	4	4	4	1	10	13	4	4
	181-190	4	1	4	1	10	13	4	4
	191-200	4	1	4	3	10	13	4	4
	201-210	4	1	4	3	10	13	4	8
	211-220	4	1	4	3	10	13	4	8
	221-230	4	5	4	5	10	13	4	13
	231-240	4	5	4	5	8	13	4	13
	241-250	4	5	4	5	8	13	4	13
	251-260	4	5	4	5	8	13	8	13
	261-270	4	5	4	5	8	13	8	13
	271-280	4	5	4	3	8	13	8	2
	281-290	4	5	4	3	8	13	8	2
	291-300	4	5	4	3	8	13	8	2

4.2 Learning and Evaluation (Phase 2)

The second phase of this research measured changes in participants' knowledge and confidence from viewing either the student-designed or the tutor-designed learning object, with an evaluation of the specific resource viewed.

4.2.1 **Sample**

The number of participants recruited to this phase of the research was 119 from 421 year one nursing students, over three intakes to the course (Table 4-10).

Table 4-11 Learning measure and evaluation sample

	Student designed RLO	Tutor designed RLO	Total
Cohort A	3	5	8
Cohort B	9	8	17
Cohort C	46	48	94
Total	58	61	119

The knowledge and confidence in knowledge scores were normally distributed with bell shaped curves evident when the data was plotted on a histogram (Figure 4-7). In addition, a Levene's Test for Equality of Variances statistic was used to determine homogeneity of variance and which SPSS output should be used when the student t test was applied to the data.

There was no significant difference in the participants pre intervention knowledge score whether they viewed the student-designed (M=4.3, SD=4.7) or the tutor-designed learning object (M=4.4, SD=4.0); t (117) = -.21, p=.83 (two-tailed). The size of the difference in the means (mean difference =-0.17**,** 95% CI: -1.8 to 1.4) was nil (eta squared=0.00).

There was no significant difference in the participants pre intervention confidence score whether they viewed the student-designed learning object (M=5.4, SD=1.5) or the tutor-designed RLO (M=5.3, SD=1.8); t (117) = -.28, p=.78 (two-tailed). The size of the difference in the means (mean difference =-.09, 95% CI: -.5 to .7) was nil (eta squared=0.00) confirming there appeared no difference between the groups' knowledge and

confidence in knowledge score prior to viewing their assigned learning object.

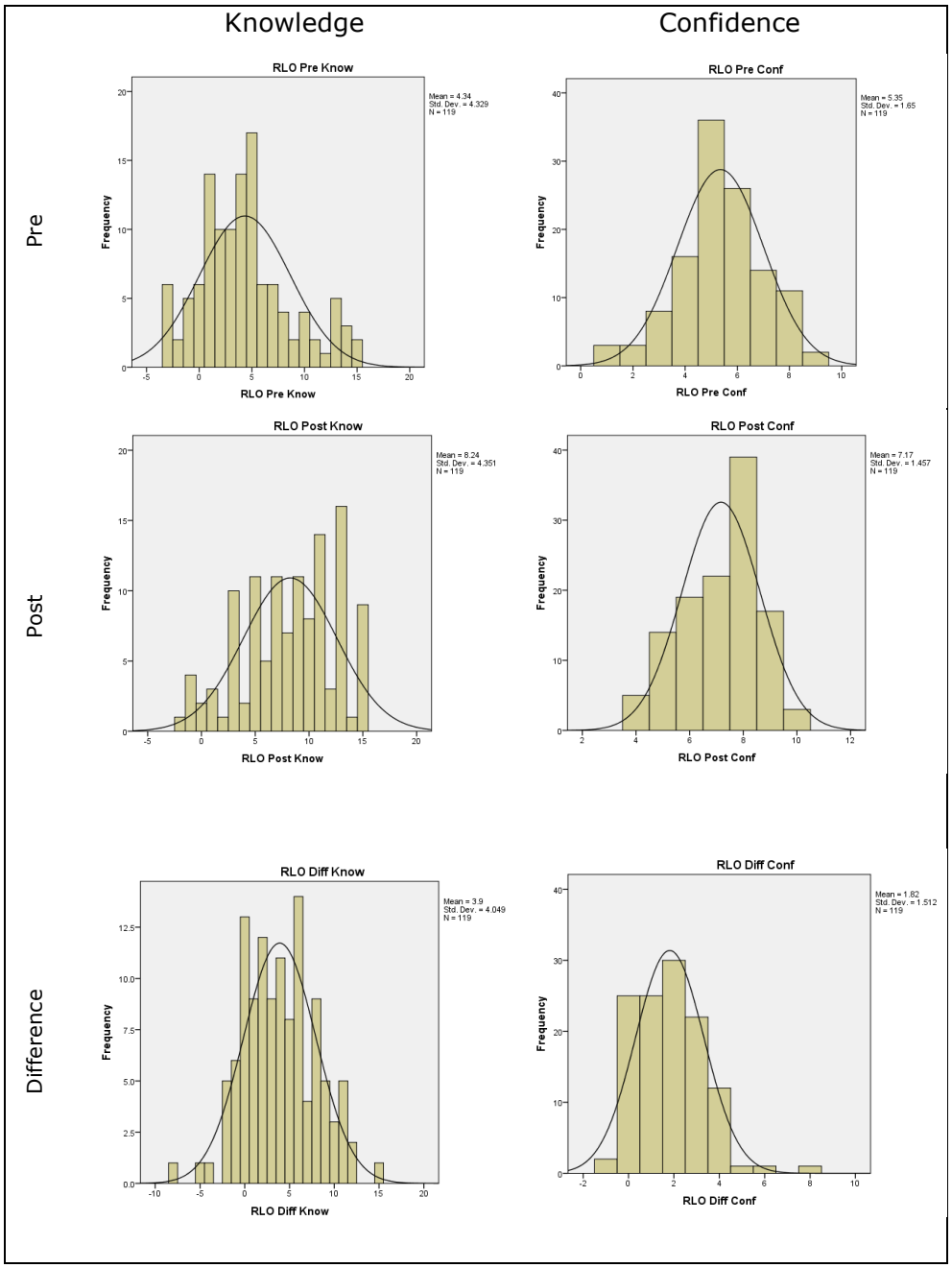


Figure 4-7 Knowledge and confidence normal distributions
Figure 4-7 displays six histograms of the data showing it was was reasonably normally distributed to meet one of the assumptions to apply parametric statistical tests

4.2.2 **Results of Knowledge Measures (RQ2a)**

A paired samples t test was applied to the pre and post intervention mean knowledge scores of participants who viewed the student-designed and the tutor-designed learning object. An independent samples t test was performed to analyse the difference in mean knowledge scores of participants who viewed the student-designed learning object and the tutor-designed learning object with results presented in Table 4-11 and Figure 4-8 and 4-9.

Table 4-12 Knowledge scores

	Student-designed RLO 01 n=58 Mean (SD)	Tutor-designed RLO 02 n=61 Mean (SD)
Pre intervention knowledge	4.3 (4.7)	4.4 (4.0)
Post intervention knowledge	8.3 (5.0) p=.000	8.2 (3.7) p=.000
Difference in knowledge	4.0 (4.5)	3.8 (3.6) *p=.79 ns*

<u>Post intervention knowledge who viewed student designed RLO</u>

There was a statistically significant increase from the pre (*M=4.3, SD=4.7)* to post (*M=8.3, SD=5.0*; *t(57)=6.75, p=.000)* intervention knowledge score of participants who viewed the student-designed learning object. The mean increase in score was 4.0 with a 95% confidence interval ranging from 2.8 to 5.2. The eta squared statistic (.44) indicates a large effect.

<u>Post intervention knowledge who viewed tutor designed RLO</u>

There was a statistically significant increase from the pre (*M=4.4, SD=4.0)* to post (*M=8.2, SD=3.7*; *t(60)=8.28, p=.000)* intervention knowledge score of participants who viewed the tutor-designed learning object. The mean increase in score was 3.8 with a 95% confidence interval ranging from 2.9 to 4.7. The eta squared statistic (.54) indicates a large effect.

Difference in knowledge

There is no significant difference in the participants' knowledge score change whether they viewed the student-designed (*M*=4.0, *SD*=4.5) or the tutor-designed learning object (*M*=3.8, *SD*=3.6); t (117) = -.21, *p*=.79 (two-tailed). The size of the difference in the means (mean difference =-.19, 95% CI: -1.3 to 1.7) was nil (eta squared=0.00).

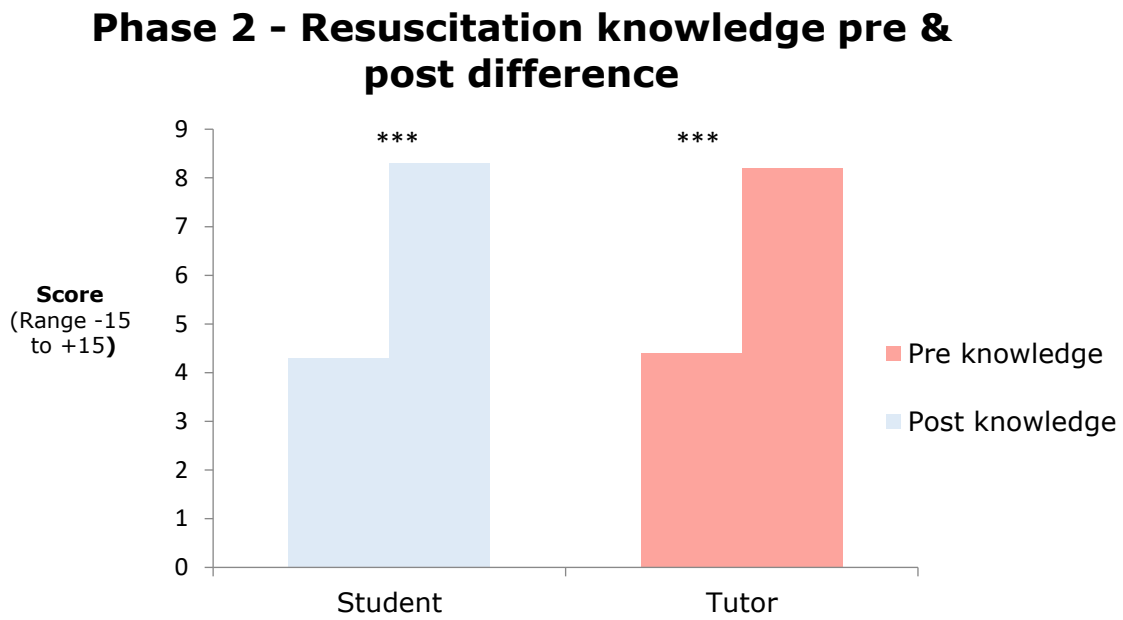


Figure 4-8 Resuscitation knowledge pre and post difference
Figure 4-8 displays the pre and post intervention participants' resuscitation knowledge, whether they viewed the student-designed or tutor-designed RLO. ****p<0.001*

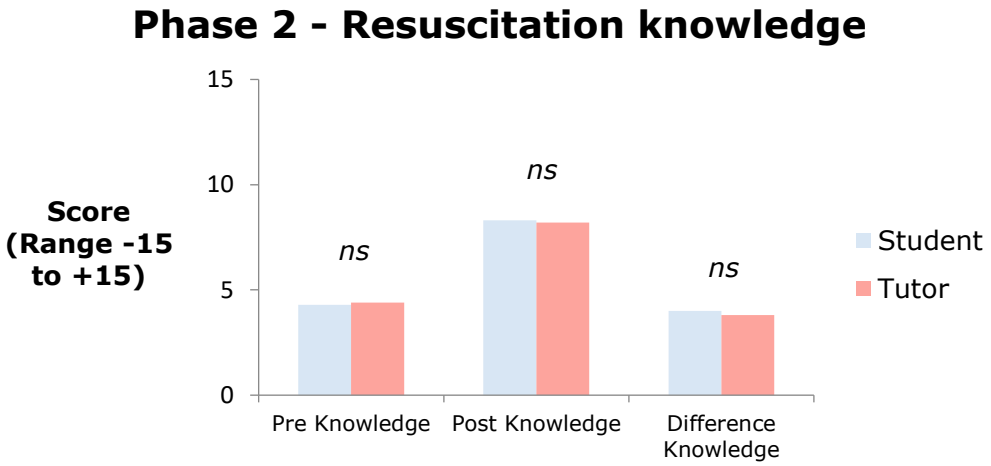


Figure 4-9 Student-designed and tutor-designed RLO knowledge scores
Figure 4-9 compares the pre, post and difference in resuscitation knowledge between participants who viewed the student-designed and tutor-designed learning object.

4.2.3 **Results of Confidence in Knowledge Measures (RQ2b)**

A paired sample t test was applied to the pre and post intervention mean confidence in knowledge scores of participants who viewed the student-designed learning object and then to the pre and post intervention mean confidence in knowledge scores of participants who viewed the tutor-designed resource. An independent samples t test was performed to analyse the difference in the mean confidence in knowledge score of participants who viewed the student and the tutor designed RLO, with all results presented in Table 4-12 and Figure 4-10 and 4-11.

Table 4-13 Confidence in knowledge scores

	Student designed RLO 01 n=58 Mean (SD)	Tutor designed RLO 02 n=61 Mean (SD)
Pre intervention confidence	5.4 (1.5)	5.3 (1.8)
Post intervention confidence	7.5 (1.5) *p=.000*	6.9 (1.4) *p=.000*
Difference in confidence	2.1 (1.7)	1.5 (1.3) *p=.042*

<u>Post intervention confidence in knowledge, student-designed RLO</u>

There was a statistically significant increase from the pre (*M=5.4, SD=1.5)* to the post (*M=7.5, SD=1.*5; t*(57)=9.52, p=.00)* intervention confidence in knowledge score of participants who viewed the student-designed learning object. The mean increase in score was 2.1 with a 95% confidence interval ranging from 1.7 to 2.6. The eta squared statistic (.61) indicates a large effect.

<u>Post intervention confidence in knowledge, tutor-designed RLO</u>

There was a statistically significant increase in the pre (*M=6.9, SD=1.4*) to the post (*M=5.3, SD=1.8)*; *t(60)=9.36, p=.000*) intervention confidence in knowledge score of participants who viewed the tutor-designed learning object. The mean increase in score was 1.6 with a 95% confidence interval ranging 1.2 to 1.9. The eta squared statistic (.60) indicates a large effect.

Difference in confidence between student-designed and tutor-designed RLO

There was a significant difference between the student-designed learning object in the confidence in knowledge score of participants (*M*=2.1, *SD*=1.7) and participants who viewed the tutor-designed RLO (*M*=1.5, *SD*=1.3); t (117) = 2.1, *p*=.04 (two-tailed), favouring the student-designed resource. The size of the difference in the means (mean difference =.56, 95% CI: .0 to 1.1) was small to moderate (eta squared=.04).

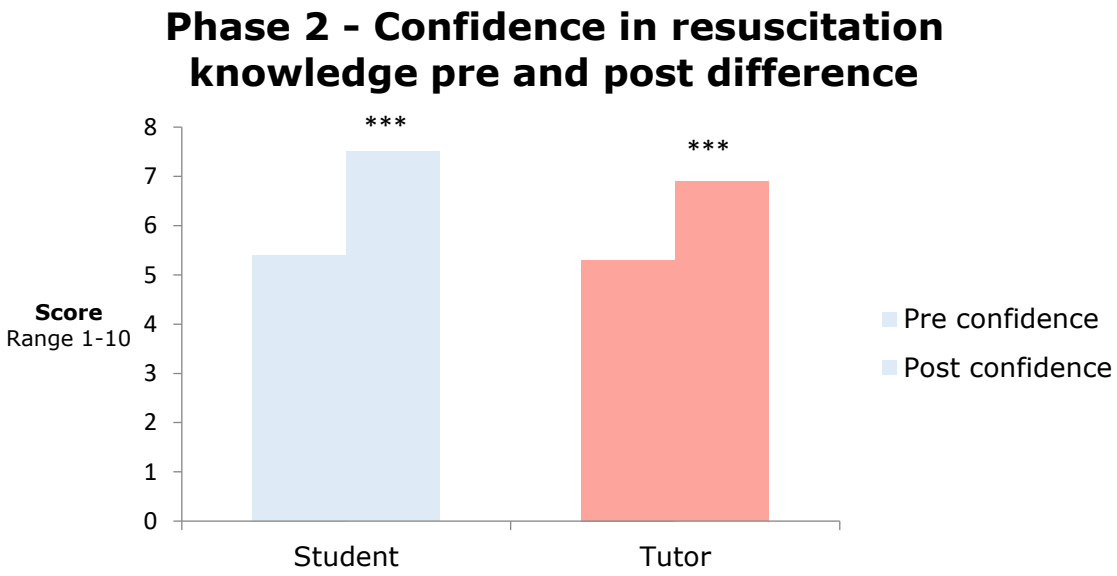


Figure 4-10 Resuscitation knowledge difference
Figure 4-10 displays the pre and post intervention participants' confidence in their resuscitation knowledge, whether they viewed the student-designed or tutor-designed RLO.
****p<0.001*

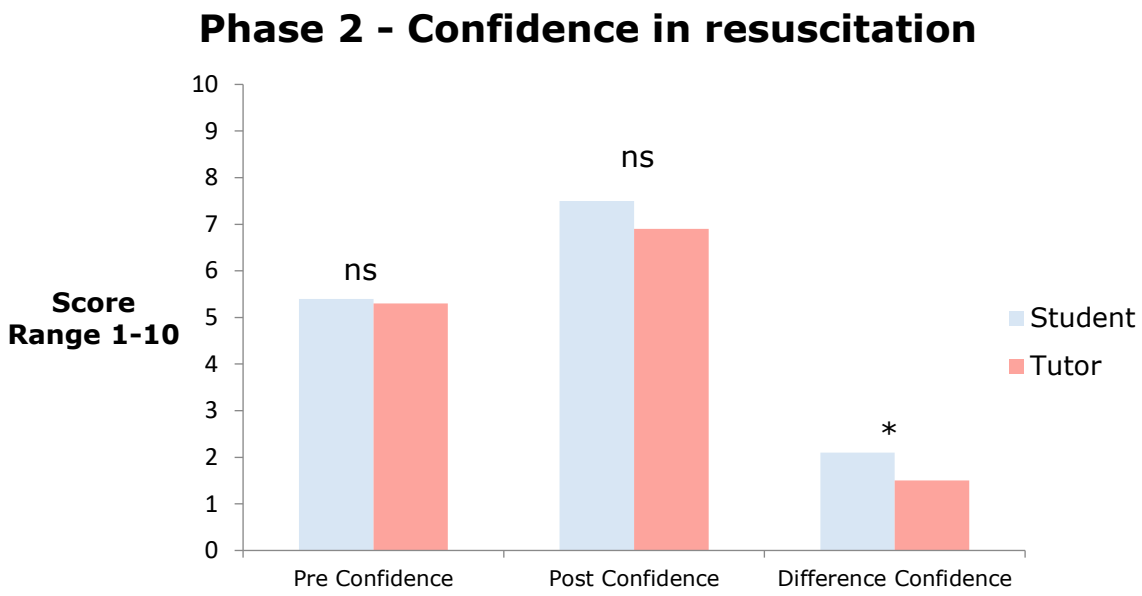


Figure 4-11 Student and tutor designed RLO confidence scores.
Figure 4-11 compares the pre, post and difference in confidence between participants who viewed the student-designed and tutor-designed RLO. *$p<0.05$

4.2.4 Correlation between Knowledge and Confidence (RQ2c)

The relationship between knowledge and confidence in knowledge scores was investigated using Pearson product-moment correlation as the data met the requirements for this test to be applied (normality, linearity and homoscedasticity) (Figure 4-12).

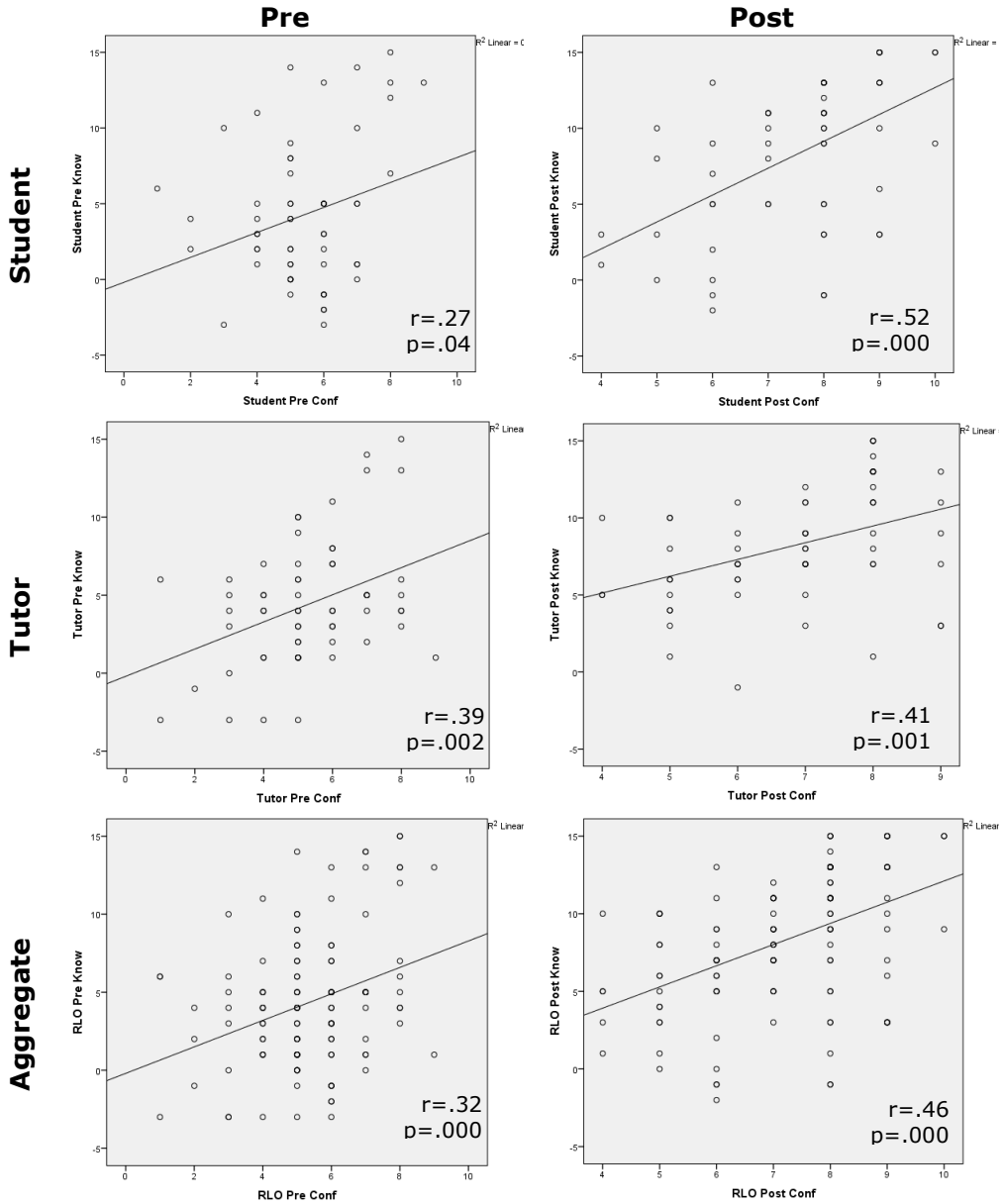


Figure 4-12 Scatterplot of knowedge and confidence scores
Figure 4-12 displays scatterplots of the correaltions between knowledge and confidence for those who viewed the student–designed learning object, tutor-designed learning object and aggregate scores, with regression lines applied to each graph.

The analysis revealed a small significant correlation between the pre-intervention knowledge and confidence in knowledge scores of participants who viewed the student-designed learning object *r= .27, n=58, p=.04* and a large significant correlation with the same participants post intervention knowledge and confidence in knowledge score *r= .52, n=58, p=.000*.

A similar result was present for participants who viewed the tutor-designed learning object with a medium significant correlation between pre intervention knowledge and confidence in knowledge scores *r= .39, n=61, p=.002* and with their post intervention knowledge and confidence in knowledge scores *r= .41, n=61, p=.001*.

When the aggregate data was analysed a medium significant correlation between pre intervention knowledge and confidence in knowledge scores *r= .32, n=119, p=.000* and with post intervention knowledge and confidence in knowledge scores *r= .46, n=119, p=.000* was evident.

4.2.5 **Analysis of Variance between Cohorts (RQ2d)**

A one-way between groups analysis of variance was performed to investigate whether there was a difference between cohorts (Cohort A, B and C). This identified no significant difference in any knowledge scores or pre or difference in confidence in knowledge scores, though a significant difference in the post confidence in knowledge scores between the groups: (F 2,116) = 3.1, *p=.047* of a small effect size eta squared (.05) was noted. Post hoc comparison using the Tukey HSD test demonstrated the mean post confidence in knowledge score for Cohort B *(M=6.4, SD= 1.5)* was significantly lower than for Cohort C *M (7.3, SD=1.4)*; Cohort A was not significantly different from either of the other cohorts (*M=6.9, SD=1.6)* though this may be influenced by the unequal cohort sizes.

4.2.6 **Learning Object Participant Evaluation (RQ2e)**

The evaluation of the student-designed and tutor-designed learning object provided over one hundred comments from participants with the resource deemed overwhelmingly helpful and consequently the student and tutor data has been presented together for simplicity, unless otherwise indicated. One hundred and two participants stated the resource was helpful or very helpful, four said it was not helpful and no one said it was

unhelpful; there were thirteen participants who did not respond to the question (Table 4-14 & Figure 4-13).

The participants accessing either learning object experienced very few problems in using the resource with only two reporting technical issues, one expressing difficulty with the resource, three commenting on the language and four making other general comment. A large majority (n=94) would recommend the resource they viewed to other learners with only two participants (one who viewed the student-designed and one who viewed the tutor-desiged learning object) stating they would not do so (Table 4-14 & Figure 4-14).

Participants expressed what they liked and disliked in the learning object they viewed with the overall data in Table 4-16 and the individual comment in Tables 4-17 to 4-20, with the narrative categorised by applying the LOAM Tool pedagogical factor sub-headings of Activity, Environment and Roles.

Table 4-14 participant evaluation of RLO usefulness

	Student designed	Tutor designed	Total
Very helpful or helpful	52	50	102
Not helpful	2	2	4
Total	54	52	106

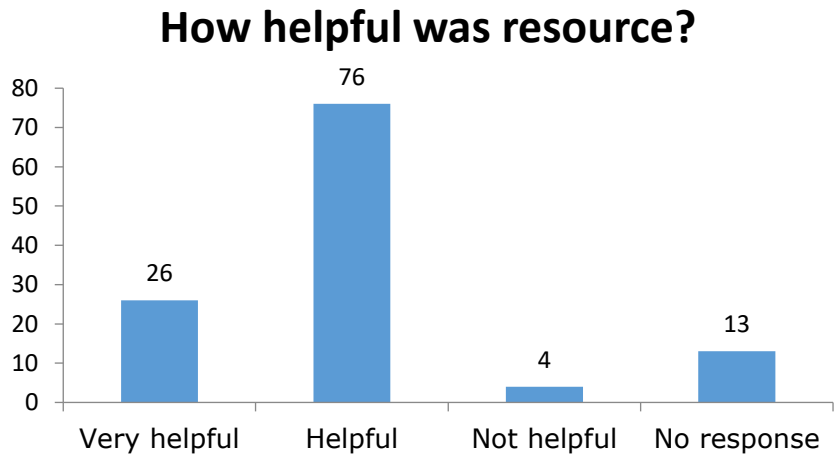


Figure 4-13 User evaluation of RLO usefulness
Figure 4-13 shows the aggregate data indicating an overwhelming view a student-designed or tutor-designed learning object was helpful for learning.

Table 4-15 Participant evaluation- would recommend resource?

	Cohort A		Cohort B		Cohort C		Totals
	Student designed	Tutor designed	Student designed	Tutor designed	Student designed	Tutor designed	
Yes	3	5	9	8	38	31	94
No	0	0	0	0	1	1	2
	3	5	9	8	39	32	96

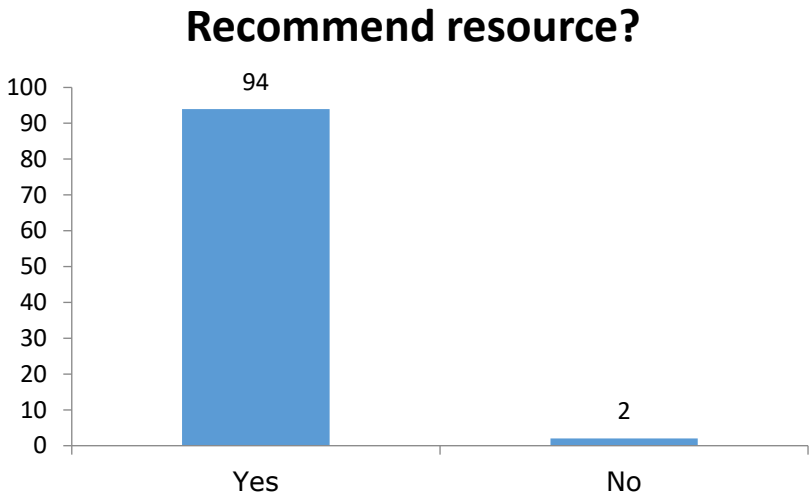


Figure 4-14 User evaluation - would recommend resource?
Figure 4-14 shows the vast majority of the participants who answered the question would recommend the resource to others. A quantitative analysis of the descriptive evaluation data is presented in Table 4-16 and a qualitative analysis of the comments from users was summarised in Table 4-17 to 4-20.

Table 4-16 Summary of learning object user evaluation

	Liked most comments from users n (%)		Liked least comments from user n (%)	
Sub heading and total number of comments	Student designed	Tutor designed	Student designed	Tutor designed
Activity (49)	18 (30.5)	23 (41.1)	5 (22.7)	3 (11.5)
Environment (80)	39 (66.1)	20 (35.7)	10 (45.5)	11 (42.3)
Roles (34)	2 (3.4)	13 (23.2)	7 (31.8)	12 (46.2)
Total	115		48	

Table 4-17 Liked most about student designed learning object

LOAM Tool Pedagogical factors sub-headings		
ACTIVITY	ENVIRONMENT	ROLES
(alignment, assessment, navigation, interactivity)	(media-richness, context, integration, objective)	(self-direction, feedback, support, pre-requisites)
Videos; the videos where very helpful; the video and being able to see the task being done; Clear and precise; Use of video; being able to listen and also read along; real life scenario; Simple, effective video of the process is good for illustration added with verbal instruction; Easy to understand; The information and how effective it was; Good mix of videos and information; Easy to absorb the information; The explanation and then viewing the video of what was said; The re-enactment made it easy to remember and follow. What to do when someone has a cardiac arrest; Good level of information provided without being overwhelming or patronising; learn best and take more information in when I read so I liked it had audio all one way; Short, informative, good use of audio; Easy to understand; Insight into CPR; How simple it was and wasn't confusing to try to understand; It was clear and easy to understand the information Videos; It has sound and written text to what is said as well as videos to explain; Clear and simple; uses different media i.e. videos, voiceover, text to explain the scenario; Videos; The detailed video of how to perform CPR; Simplicity Very informative and uses a video to show you Simple, effective video of the process is good for illustration added with verbal instruction; Easy to understand; The video and being able to see the task being done; Clear and precise; Use of video; being able to listen and also read along;	CLEAR AND EASY TO FOLLOW; Slow, easy to follow; Easy to use; it was clear, simple easy to find and use; Its simple and straight forward; Simple, easy to use; I could go at my own pace and go back if I felt the need to; Very clear presented information in a straightforward and unambiguous way; Could go over and revisit the slides; Slow pace and step by step; Interactive; Can pause and go back so can study at own pace; it was a slow pace to work at; The questions after the clips; That there was a questionnaire, it also went through a full sequence at the end; It was clear and easy to follow;	common sense based questions; Can go at your own pace, stop and start when wanted to;

Table 4-18 Liked most about tutor designed learning object

LOAM Tool Pedagogical factors sub-headings		
ACTIVITY	ENVIRONMENT	ROLES
(alignment, assessment, navigation, interactivity)	(media-richness, context, integration, objective)	(self-direction, feedback, support, pre-requisites)
the demonstartions *(sic)*; straight forward; very informative; The videos; easy to watch, no technical problems; explanatory; The clarity of the video and voiceover. The fact there were informative images and demonstrations as well as writing; Visual learning works well; The clips showed you how to put it into practice; Also reviews the whole thing at the end; There was both audio and written language; It showed clips to demonstrate what was being said; Not much to read can listen to it; It shows you a video to demonstrate; The way in which it was narrated as well as being allowed to read what was being said; Clear video; Animation; very informative; Clear and precise; The videos	easy to follow and informative; Clear and precise; Step by step instructions; Very clear and well sequenced. easy to understand; Ability to re watch scenario at the end to re-establish the sequence of events; It paused to test knowledge after explanations; Explained things in simple term, easy to follow; Easy to follow, both video and written information; Clear and concise and easy to follow; Easy to use and self-explanatory; You could repeat if answered questions wrong; Easily understood. Simple; Broke down each stage clearly; The interactive aspect; Also the fact you can go at your own pace; Clear and easy to use; Interactive; Easy to follow; it was easy to understand; Went through step by step to make it easier to understand; Step by step instructions; Very clear and well sequenced; easy to follow and informative;	Simple to use; it reinforces learning effectively with quizzes; Plenty of information , key points; Quiz because it assesses my knowledge/learning; How it shows you an example of somebody actually collapsing; I have previously been on first aid courses a few years ago and this resource has refreshed my memory. It was very informative and easy to use; Quiz and then shows what to do, test knowledge; Also that there was a quiz to test my knowledge; test your knowledge with quizzes; and kept you interested with quizzes easy to watch, no technical problems; explanatory; straight forward

Table 4-19 Liked least about student designed learning object

LOAM Tool Pedagogical factors sub-headings		
ACTIVITY	ENVIRONMENT	ROLES
(alignment, assessment, navigation, interactivity)	(media-richness, context, integration, objective)	(self-direction, feedback, support, pre-requisites)
can't listen to the audio in the library; THE ACTORS; Reliance on audio sub titles or text boxes preferred; May have re-iterated the video too often I see the use of it as a reference for the points being made, but I don't think it needed to be played through three times; The video repeating; Repeated video could of may be paused out at each step just to go over again what each bit is; ne of voice throughout the resource – monotone; The voice is very monotone; he video I found was quite confusing; The narrators voice got boring. The video could be more interactive	Couldn't read the information quick enough; If you want to recap a particular section it is difficult to know which slide you need; Too drawn out, laborious; It was a little quite (sic), needed a little more information whilst demonstrating; It didn't show how a recovery position is done, Since it concentrated on cardiac arrest, other accidents i.e. concussions show to deliver first aid can be different. For example not shaking them. Confused as I didn't see the lady in the video checking the pulse?	the amount of text in each speech bubble; Does the head tilt stop the tongue?; My answers could be wrong; It didn't go into a lot of detail; it would nice to be longer, fill with more information; Different words to ones on screen than being spoken; Could of (sic) explained in more detail;

Table 4-20 Liked least about tutor designed learning object

LOAM Tool Pedagogical factors sub-headings		
ACTIVITY	ENVIRONMENT	ROLES
(alignment, assessment, navigation, interactivity)	(media-richness, context, integration, objective)	(self-direction, feedback, support, pre-requisites)
Bad acting; The voice was a bit slow; The robotic voice; Some of the questions did not relate to the video information; Would be useful to have a concise written summary of the procedure, rather than just watching the video clip; The talking was too quick to follow and be able to take the information in; Not very modern; The video wasn't very modern; The voice was a little droany; Not all information in the questions was covered; How slow the speech was on the headphones;	Not always able to read information on the side while video was being shown; Didn't respond quickly when clicking; The time at the bottom was quite distracting; Time on each slide was too short	not all the questions were answered in the video that were asked in the questionnaire; It was very basic and also so are the questions eg do you give 5 rescue breaths- yes no or don't know. if it is a child you do give 5 first but an adult you don't so not explanatory; Not very many test questions and not on all aspects; With the audio slow for writing to come up sometimes; It could have gone into more details, explained a bit more.; Not all questions were answered by the video; Short factual info may be better than paragraphs; Not all areas covered like pulse, rescue breaths; The quiz where you had to say where you would place your hands - its hard to judge on a picture; The level of detail was not as much It did not mention pulse in the video; not all the questions were answered in the video that were asked in the questionnaire

5 Discussion

This research has investigated how a group of students and separately a group of tutors design a learning object for novice nursing students to learn established resuscitation knowledge in order to determine whether these groups approach this differently, and if so whether differences influence alignment and effectiveness. The results demonstrate digital resources can be an effective way of learning and there are advantages in process when students are prominent in the design process and indeed differences in the final resource. By applying the Agile Development Methodology (Boyle et al, 2006; Wharrad and Windle, 2010) that has a proven record in learning object design and investigating whether student-designers can add value to the process, insight that can assist all resource designers has been uncovered – see **Main Findings** below.

Moreover, the results of this work have greater implications in helping us understand the processes and value of user-generated content more generally, giving insight to the pedagogical elements that are incorporated and appreciated. Such a detailed interpretation of how learning objects used in higher education has not been conducted previously. The main findings are listed below and are then discussed using three models, namely:

1. Kirkpatrick's Four Level Evaluation to analyse the Learning and Evaluation data (Kirkpatrick, 1996)
2. Tuckman's stages of group development model (Tuckman, 1965)
3. The Learning Objects Attribute Metric (LOAM) Tool (Windle et al, 2007)

The models were selected because of their applicability when applied to the data collected, their strong theoretical background (see Section 3.1.3.4) and are justified in the relevant section of this chapter.

Main Findings

- A significant increase in participants' knowledge and confidence in knowledge as a result of viewing the learning object, whether the resource was designed by students or by tutors.
- A significant difference in the increase of the participants' post viewing confidence in knowledge, favouring the student-designed learning object.
- Students and tutors function differently when working as a homogenous group in the design of an learning object, with students spending significantly less time settling (forming) and in conflict (storming) and significantly more time in the identifying solutions (performing).
- Tutors spent significantly more time discussing the *objective* of the resource, whilst students spent significantly more time discussing how learners *navigate* a resource. The longer time spent by tutors discussing the objective may be related their greater clinical and academic experience and less time spent discussing navigation because of assumptions about how students technological capabilities in the Information Age. Most of the other pedagogical characteristics considered by participants were given similar (*assessment, interactivity, integration, feedback*) or minimal (*media-richness, context, self-direction, support or pre-requisites*) or no (*alignment*) prominence by both students and tutors when measured by the amount of discussion time.
- Both learning objects were well received by participants with the vast majority stating the resources were helpful or very helpful for learning and would overwhelmingly recommend the resource they viewed, with participants' quantitative responses and qualitative free text comment supporting this finding.

By applying a grounded theory methodology for this investigation it has been possible to acquire and analyse qualitative and quantitative data from the Storyboard Workshop (phase 1) and the Learning and Evaluation (phase 2) components of this study uncovering aspects of the design and effectiveness of student–designed and tutor-designed learning objects. This chapter will discuss the results to show the positive learning and evaluation from RLOs and explain how those facilitating the production of RLOs can

ensure the designers function more effectively in a group and why pedagogical considerations should be integral in their work. As Kirkpatrick posits every educational project should include a robust evaluation of learning and the impact on an organisation and not just the user reaction to an educational or training intervention. In this project, changes in knowledge and confidence in knowledge were measured in addition to user satisfaction with the look and feel of the learning objects (Kirkpatrick, 1996).

5.1 Knowledge Acquisition and RLOs

This work investigated the initial acquisition of knowledge and confidence in their knowledge by participants using student-designed and tutor-designed learning objects to establish any learning effect, as it is important to know whether an educational intervention enhances or hinders learning. However, any assessment of learning requires a tool, with Kirkpatrick's Training Evaluation model (Kirkpatrick, 1996) providing a framework as in addition to learner satisfaction, the model suggests changes in learner's knowledge and skills, the application of that learning and ultimately an organisation's results should be assessed. This investigation has shown that the learning objects used to acquire knowledge did indeed have a significant positive impact on students, showing learning objects to be an effective intervention with Brooman et al (2015), Keefe & Wharrad, (2012) and Woolmer et al (2016) investigations already demonstrating this effect.

This study focused on what has been defined here as established knowledge, with that definition taken to mean knowledge that has been accepted by a discipline with a clear evidence base. The reason established knowledge was chosen acquiring established knowledge is part of a university student's academic life, providing a foundation from where they can expand their education. It should be noted that established knowledge may differ in nature from other forms of knowledge in a discipline, that we might call experimental, developmental or reflective knowledge. Established knowledge is unambiguous and whilst it may change over time, for example as a result of experimental knowledge investigations, disciplines accept established knowledge as a foundation of their work.

The acquisition of established knowledge is essential so students can build on this foundation in their studies with Kneebone and Nestel (2015) noting

the applicability of Vygotsky's Zone of Proximal Development to learning in the Information Age. The original theory developed from work in the early twentieth century included the concept of "more knowledgeable others" referred to as teachers. However in the twenty-first century because of technology and changes in society, the teacher could be a learning object or a senior student (also see section 1.3 & 2.1); by integrating senior students in the design process, learning objects may be more aligned to their peers needs and is discussed in Section 5.2.

5.1.1 Learning object and classroom knowledge acquisition

The potential for online learning as an alternative to classroom instruction has been demonstrated by Hale, Mirakian & Day (2009) investigation of classroom and online learners using pharmacology education resources (online presentations and videos) by nursing, dental hygiene and allied health professional students. With no randomisation of participants as the students selected whether to undertake the taught or online pharmacology course, the investigators tested participants' learning styles and found no significant difference between each group. There were many more participants in the classroom intervention (n=107) than the online course (n=26) as student numbers were capped for the online element. It is unclear why this was done as the provision of online learning is not normally limited by factors such as classroom size or tutor availability. Standard classroom education employed lectures with the online participants viewing videos of the same material, though as they were also made available to the classroom participants it is not possible to exclude their effect on the control group. The measures used to assess the effectiveness were examination scores, course withdrawal rates and student satisfaction, with no significant difference in any measure apart from a higher percentage of students using RLOs receiving grade 'A' in their assessment (38% v 29%, $p=.001$) identified. In their qualitative comments, participants significantly favoured a classroom experience in collaborative components, developing a rapport with colleagues, their perception of learning and their overall experience, again suggesting a blended leaning and not completely online educational experience is preferred.

A much larger study Windle, McCormick, Dandrea & Wharrad (2011) investigated whether six RLOs explaining chemistry for nursing students facilitated learning. It identified a significant improvement in knowledge in participants (n=118) who accessed digital resources with tutor support or as part of self-directed study, when compared with previous cohorts (n=139) with no access to RLOs. Whilst the authors acknowledge a direct comparison of learning was not possible, a significant difference in knowledge acquisition was identified favouring RLO use whether or not with tutors, when compared with summative examination marks from previous cohorts at the same stage of study.

Dolan, Hancock & Wareing (2015) investigation of ECG knowledge and practical electrode placement abilities of junior health science students (radiography, physiotherapy, occupational therapy and sports science) continued to confirm that online learning provides no worse outcome when they compared traditional classroom teaching and learning using tutor designed RLOs based on the classroom material. Though the sample size was small with no power calculation, no significant difference in each group's mean MCQ score was reported suggesting online learning is as effective as classroom instruction.

The research described in this current thesis randomly assigned phase 2 participants to view a student-designed or tutor-designed RLO in learning resuscitation knowledge and assessed their pre and post viewing RLO knowledge and confidence in their knowledge scores. This allowed a comparison of the learning achieved and demonstrated statistically significant knowledge acquisition irrespective of the designer, supporting the findings of Windle et al (2011), that learning objects can be used in a similar role to that of teachers for novice learners to acquire established knowledge.

5.1.2 Patient/service user learning object knowledge acquisition

A measurable improvement in knowledge by viewing RLOs is not restricted to students with Ferguson, Brandreth, Brassington et al (2015) study of learning objects use by patients referred to an audiology service, adopting a Participatory Design approach and the Agile Development Method (Boyle et al, 2006; Wharrad and Windle, 2010) in creating the resources. Two hundred and three participants recruited from patients attending an

audiology clinic were randomised to receive either a standard information or standard information and access to learning objects, measuring knowledge and practical hearing aid handling skills using instruments employed in other published work. The study was sufficiently powered and demonstrated a significant improvement in practical and knowledge aspects of hearing aid use for participants who used learning objects in addition to standard care over those who received standard care alone. The results demonstrated access to education through the use of well-designed learning objects provides clear evidence of learning and as the resources are accessible as the user wishes, facilitates easy access to refresher training. Moreover, as the resources were designed with hearing aid user involvement as stakeholders, the design of the learning object was aligned to hearing aid users' needs, drawing from Vygotsky's Zone of Proximal Development. As participants in the intervention arm of Brandreth et al, (2015) investigation also had access to standard care, this work supports a blended tutor and technological approach to learning. However they did not investigate whether patient (i.e. student) or practitioner (i.e. tutor) designed RLOs conferred additional learning gains and is why this research investigating student-designed and tutor-designed learning objects is necessary.

The investigations reported above and this study confirm RLOs are effective when used to learn established knowledge, though it is not known who may be best placed to design these learning objects. As established resuscitation knowledge once acquired has been identified to decay within as little as three months (Soar, Mancini, Bhanji et al., 2010), it may be a student-designed learning object is more aligned to the learner needs, though will require further longitudinal research to confirm if this is the case.

5.2 Confidence in Knowledge after viewing RLO

In addition to demonstrating a confidence in knowledge was significantly enhanced when either the student-designed or tutor-designed RLO was viewed, a significant difference in confidence in knowledge favouring the student-designed learning object was identified. So why should a student designed learning object confer greater confidence in the participants' knowledge? It is possible the student designers are more aligned with the needs of their peers and unconsciously aware of the cognitive demands

that affect learning. In effect, are students more attuned than tutors to their peers learning needs? Recalling Vygotsky's Zone of Proximal Development described as an area for learning to occur with the support of "more knowledgeable others" – where learners are supported by tutors – senior student may be better positioned to assist their peers in bridging this knowledge gap. They may be more able to recall the challenging aspects of acquiring new knowledge when they first learnt resuscitation, have a greater awareness of what enhanced their learning and be able to translate this into their design of an learning object.

5.2.1 **Self-efficacy**

The confidence an individual has in their ability to perform a task is important because if an individual possesses specific knowledge though are not confident in applying it, their learning will not be visible. In an adult educational environment asking a question for students to answer, is more of a skill than may first appear (Fry, Ketteridge & Marshall, 2009). A reticence in offering a reply may be because students' were thinking about their response or a tutor poorly worded a question. However, the engagement of a student is considered to be partially determined by their academic confidence (Bandura, 1977; Fry, et al 2009) and Rowbotham & Owen's (2015) investigation of 236 nursing students demonstrated the importance of self-efficacy and teaching behaviour can positively or negatively influence learning. Vygotsky's social constructivist learning theory identified the importance of a teacher in student learning (see section 1.3) and when an learning object is used in a self-directed learning setting, it is necessary to pay close attention to the design of these resources to ensure they are as effective as possible.

Social cognitive theory (originally referred to as social learning theory) and the concept of self–efficacy was proposed by Albert Bandura to explain how individuals respond to challenging circumstances. Those more able to cope are identified as possessing a higher self-efficacy, reflecting their confidence about an ability to achieve a goal (American Psychological Association, 2016; Bandura, 1977; McMullan, Jones & Lea 2012). This was discussed extensively by Bandura (1977) with a concept analysis by Zulkosky (2009) summarising self-efficacy as the perception an individual has in completing a task and a literature review by Leigh (2008) identifying its' importance in patient care. The level of control an individual has "over one's own motivation, behaviour and social environment" (American

Psychological Association, 2016) contributes to their self-efficacy. When self-efficacy is considered in education, a belief one can learn knowledge or a skill appears an important factor to the individual's success. In class, a tutor can influence the learning, whether that is positively or negatively (Fry, Ketteridge & Marshall, 2009) and if learning objects are used in place of tutors to acquire knowledge, it is important the design process of these resources is understood. By measuring if a learning object enhances a student's belief in their ability, evidence may be acquired to support the wider use of the digital learning resources. This investigation identified viewing either a student-designed or a tutor-designed learning object resulted in a significantly increased confidence for the participants, with this effect facilitating novice students acquisition of resuscitation knowledge.

Bandura's social cognitive theory discussed in Section 5.2.1 suggests a stronger belief in abilities will reinforce the individual's belief in their achievement; success enhances expectations of achievement with failure, particularly early on causing a detrimental effect. This suggests how feedback to learners is delivered should be carefully considered. The learner should be challenged to succeed as the achievement of simple tasks provides little additional information for the learner, though this will need to be balanced as an early failure may be more destructive to a student's confidence in their abilities (Bandura, 1982). By measuring a learner's confidence in their knowledge acquisition and comparing educational interventions it may be possible identify approaches that enhance learning.

A number of authors including Chesser-Smyth & Long (2012) who investigated junior students' self-confidence, Pike & O'Donnell (2010) study of simulation, McMullan, Jones and Lea (2012) investigation of medicine calculations learning and Levett-Jones, Kenny, Van der Riet et al (2009) on motivation, discuss self-efficacy in nursing students. In all studies enhancing self-efficacy was identified as important with Chesser-Smyth & Long (2012) reporting it was essential to embed it in the design and delivery of an undergraduate nursing curriculum and Pike & O'Donnell (2010) identifying a more realistic learning environment achieved through simulation enhanced self-efficacy. McMullan, Jones & Lea (2012) reported a "…strong, significant relationships between anxiety, self-efficacy and

ability." in medication calculations, with Levett-Jones et al (2009) identifying self-efficacy provided a stimulus to learning. This resesarch into student-designed and tutor-designed learning objects also investigated the effect self-efficacy could contribute in learning established knowledge, as it is clear this concept is an important element in nurse education.

Chesser-Smyth & Long (2012) undertook mixed methods research commencing with a survey to understand what factors enhanced the participants (n=435 Irish undergraduate students) self-efficacy, then acquiring a purposive sample of 20 students from three fields to interview and reviewed their curriculum. The authors found a great variation in the participants self-confidence with clinical practice identified as an influential factor. When self-confidence increased so did the participant's motivation to achieve in academic aspects of their studies and when negative aspects of practice dominated (poor mentors, a lack of communication and not feeling valued) their self-confidence decreased. Pike & O'Donnell (2010) acknowledged small scale investigation of nursing students' (n=9, sample drawn from unpublished Master's level study) belief of self-efficacy when exposed to simulation learning, identified a lack of belief in communication abilities and the importance of authenticity in learning. When students are the designers of a learning object, they may be more attuned to how information is best represented in a resource and therefore enhance the credibility of a resource for novice learners, again linking to Vygotsky's Zone of Proximal Development.

McMullan et al (2012) investigated the abilities of 229 nursing students' medicine calculation abilities and identified a positive relationship between maths self-efficacy and achievement as Bandura's social cognitive theory suggested decades earlier. Levett-Jones et al (2009) large scale explorations of self-efficacy in nursing students' highlights how important it is for learners to have confidence in their abilities, whether this is in relation to their subject or as Todhunter (2015) identified when using technology. Both studies recruited large samples (n=971 and n=375 respectively) where Levett-Jones and colleagues further explored self-confidence with 24 participants in four separate focus groups. These papers identify Bandura's self-efficacy to be important to nursing students learning and it is quite possible the concept is applicable to the wider health professional student population.

Students' value direct one to one support, the extent to which they are challenged by a resource and what assistance is available (whether that is accessed online or from a person) and these aspects should be considered by resources designers and will be discussed in Section 5.4. The effect an educational intervention has on enhancing an individual's self-efficacy appears clear and identifying approaches that enhance this when investigating novel learning opportunities may provide evidence supporting the use of learning objects.

When considering self-efficacy and knowledge it is important to ensure a balance is achieved as knowledge without confidence may result in an inability to intervene and apply the learning in a practical environment. Alternatively, confidence without knowledge could lead to unsafe practice, with both outcomes undesirable in the healthcare environment. The importance of nursing students possessing sufficient self-efficacy is they need to act in a professional and competent manner, whilst not displaying over confidence that could lead to unsafe actions potentially harming patients. In this study appropriately enhancing the belief of a nursing student they possess sufficient knowledge to perform CPR effectively may encourage them to do so, contributing to the survival of an individual who has suffered a cardiac arrest.

5.2.2 **Cognitive Load Theory**

Sweller (1988) developed cognitive load theory (CLT) in relation to instructional design identifying the concepts of intrinsic (what is to be learnt), extraneous (how this is taught) and germane (how the learner internally organises their learning) load and refers to cognitive architecture as schema, suggesting novice learners have not developed sufficient schema to organise their learning. The inclusion of additional extraneous information negatively affects the acquisition of knowledge as the required cognitive structures have not been developed. Cognitive load theory provides a possible explanation for why students may be more attuned to the needs of their peers as they have much more recent experience of acquiring established knowledge that is new to them, with Lockspeiser, O'Sullivan, Teherani & Muller (2008) investigation supporting this view. Lockspeiser and colleagues study commenced with focus groups analysing junior medical student views on peer education using those transcripts to

develop a questionnaire 110 medical students responded to. Factor analysis was applied to the results of the questionnaire confirming the importance of social and cognitive congruent behaviour between the student and a tutor can enhance learning (Schmidt & Moust 1995) and it may be this is also present when students design learning objects to support novice students learning. Some insights about cognitive load might be inferred by looking at the LOAM footprint of the RLO as this represents the pedagogical components of each resource (Figure 4-6 & Table 4-8) and will be discussed in Section 5.4.

In the LOAM Tool (discussed later in this chapter, Section 5.4) how a user of a learning object navigates around the resource, using embedded controls (e.g. play, forward, back, whether text is available) is ascribed significantly more time by student designers and it may be this is important in the design of a resource. A learner cannot adjust the intrinsic load though the designer of a learning object can alter the extraneous load by determining how knowledge is presented. By reducing the extraneous load, a student has more capacity to organise their learning and perhaps student designers of educational resources are more aware, even if they are not conscious of this, of extraneous and germane loads and it may be this aspect influenced their design decisions. Student designers are also less likely to have a wealth of clinical experience and therefore focus on the material provided, where as tutors have a much deeper pool of knowledge by virtue of their clinical and academic career to refer to. When learning objects to acquire established knowledge are designed it may be better to work from published material such as resuscitation guidelines and not refer back to the knowledge acquired from clinical experience.

The Learning and Evaluation participants (phase 2) identified too much information presented quickly was unwelcome, supporting the development of a number of smaller complementary resources suggested by others (Wharrad & Windle, 2010; Windle, McCormick, Dandrea & Wharrad, 2011). Learning object designers should consider the volume and how quickly content is presented to the learner in a resource.

Evidence of the influence cognitive load can have on participants using an learning object is found in McMullan, Jones & Lea (2011) report of developing an e-learning package supporting medicines calculation learning

and comparing it with traditional instruction (n=229). The participants who viewed the RLO demonstrated a statistically significant improvement in knowledge and in the acceptability of an e-learning package and the control groups knowledge decreased, albeit not significantly and the authors suggest this is because the learning object exerted less cognitive load on the participants than a traditional paper based handout. All designers should be made aware of cognitive load theory by Sweller (1988) prior to a storyboard workshop, so they can apply this theory in the design of a learning object.

If students are able to assimilate learning more easily because the cognitive load upon them is lessened perhaps they will feel more able to achieve; in effect their self-efficacy may be enhanced and encourage learning? Why this may occur could be related to Biggs (1999) concept of 'constructive alignment' with student designers more attuned to the needs of other learners because they learnt this information much more recently than tutors did. This may not be a conscious decision by the student designers of the learning object though education interventions by Perkins et al (2002) discussed in Section 2.2.2.5 and Frydenberg (2013) report of a peer tutoring initiative for junior computer science students, also suggest students play an important role assisting other students' learning. When evaluating learning in this research the participants viewing their assigned learning object were blinded to the designer, strengthening the results identified. Capturing this effect in the initial design of a learning object has the potential to enhance the acquisition of knowledge because more effective resources will be available for students to use.

In this research the student-designers focussed on the published material provided, with a lack of experience in resuscitation less important as it is how designers believe established knowledge is best represented in a learning object this study investigated. This deficit when designing learning objects may be an advantage in reducing superfluous information for the resource user, as the exclusion of unnecessary material should reduce the cognitive load demanded of learners allowing them more opportunity to focus on knowledge acquisition. The American Heart Association (2015) recommends a simple and contextual approach to resuscitation education based on adult learning principles promoting the use of digital learning resources and given the robust methodology ILCOR (2017) adopt in

producing resuscitation guidelines, there can be a high degree of confidence in their recommendations. With student participants focussing their discussions on the internationally accepted resuscitation guidelines and not including extraneous material they appear to possess an innate ability to identify the importance of managing the cognitive load demanded of learners. Debate undertaken by a group during the storyboard workshop is part of the design process though if this dominates risks diverting the discussion towards less or irrelevant matters. Essentially, by simplifying the learning object design process more knowledge acquisition may be possible.

This research demonstrated viewing a learning object significantly increased the participants' confidence in their knowledge irrespective of the designer and a student-designed learning object conferred significant additional confidence in knowledge suggesting the use of digital educational resources assists nursing student learning essential resuscitation knowledge. If self-efficacy can be enhanced without fostering misplaced over confidence, the increased use of student-designed resources may promote more effective learning and safer practice.

5.3 Storyboard Workshop and Group Stages

5.3.1 The Process of Creating a Learning Object

Learning design and the design of learning objects has been discussed in Chapter One (section 1.3.3. & 1.3.4), with the Agile Development Method (Boyle et al, 2006; Wharrad and Windle, 2010) adopted in the design of learning objects for this investigation. What is not know is how designers function as a group and what pedagogical factors they discuss, when designing learning objects. Indeed though the design and development of a curriculum is understood (Fry, Ketteridge & Marshall, 2009; Walsh, 2015) this is at a strategic level, with the operational aspects of curricula left largely to the tutor's discretion and rarely is the student voice central in this process. A systematic review of medical teaching by Steinert, Mann, Centeno et al (2006) suggested faculty development programmes appeared to show positive outcomes in knowledge acquisition, skill performance, attitude and behaviour. However even though Steinert and colleagues made comment on the student/teacher relationship, the voice of the student appeared as a proxy measure of effectiveness (exam scores,

teacher ratings, behavioural changes) and not central to the design of educational resources or interventions.

The framework of activities supporting ICT (Oliver, 2007) (figure 1-4, section 1.3.3.2) illustrates the different levels that contribute to student's learning and it is how learning objects are designed that is central to this research. Guides to creating teaching materials such as that proposed by Ker & Hesketh (2003) do exist and whilst these are a useful starting point, lack a theoretical foundation, where as this investigation has provided robust evidence why student-designers may be better placed to design learning objects on established knowledge for novice learners. In reality, tutors often created resources in isolation or perhaps with colleagues and infrequently with students. By investigating how student-designers and tutor-designers function in a group and uncovering what pedagogical factors they discuss when creating a storyboard for a learning object, differences in approach may become apparent and these can be applied by other designers.

How learners can be central to learning was reported by Christopher Emdin in a blog that highlighted how school students were able to develop resources for their peers to learn established laws of physics (Mindshift, 2016) and suggests this approach is applicable in other educational environments. After Emdin was not able to engage high school students in learning Newton's Laws of Motion he asked two if they would prepare a lesson plan as homework and deliver the session on the next day. One key aspect of the 'students who acted as tutors' approach, was to engage their peers and use examples relevant to them (e.g. riding on the subway when the emergency brake is applied), rather than more abstract concepts of marbles on a low friction surface as Emdin did. Where students are integral in the design of educational materials learning established knowledge, their involvement appears to confer learning gains by increasing their confidence in knowledge acquisition (see Section 5.2) and it is how student-designers and tutor-designers function that will now be discussed.

5.3.2 How the Groups Functioned During the Workshop

A social constructivist approach to designing learning objects can refer to engaging a group or community, as well as just an individual designing learning objects. By applying Tuckman's stages of group development

model it was possible to understand how the student-designers and tutor-designers groups' functioned, so any differences could be identified and potentially exploited to enhance learning for students using a learning object to acquire established knowlewdge. In the discussion of how each group functioned during the storyboard workshop there will be reference to excerpts from the participants (Boxes 2 to 5 below) to illuminate the discussion.

The *forming* stage occurs when a group is created and during its lifecycle with both groups returning to forming on a number of occasions. Forming is characterised as "orientation to the task" by Tuckman (1965, p386) where group members first meet, establish ground rules and their purpose (see comments in Box 2). In this investigation both the student and tutor designer spent time in the forming stage with students spending significantly less time forming and progressed though the stages in a more flowing manner, whereas the tutors return to forming more often (see Visualisation, Figure 4-2 & Table 4-3). The student designers appeared to focus on the material provided and the task, making progress more efficiently to the performing stage whereas tutors with a greater knowledge and experience appeared to be distracted from the overall objective, despite both groups receiving the same instructions. Student participants' comment included finding out about each other and posing questions to confirm what was required, with tutors undertaking a similar process though including more detail (see Box 2 below).

Box 2 – Forming

Student	Tutor
S5 – shall we make a list of what we want to put in here and then like do this? S1 – yeah, yeah S4 – makes sense S1 –shall we do the aim of what we want to learn S5 – so yeah let's talk about the aim first S1 – er to understand all of these *(pointing at BLS algorithm provided as source material)* S4 – understand the theory behind basic life support	T1 – start, has anybody done these before T5 – yes one T3 – injection one T1 – I don't mind writing if that helps a bit T2 – we starting the conversation here where are we going to go, do we need animation, do we need *indecipherable*. T4 – I think that's a good idea, are we supposed to do the whole of this or just one aspect T5 – I think we're supposed to do the whole algorithm , as a stem T4 – probably the best thing to do to start with before you start with a storyboard is to, I don't know really just find out what sort of animation you would perhaps put on each one or what sort of learning T3 – can I just go back to a stage just before that where we talked about things we did and didn't like T2 – yes T3 – and maybe make a list of the things we did and didn't like in that before we get into the content T6 – I made a note of some of the things we said
S5 – I remember like last year we've done ours already. S6 – what year are you S5 – we're year 2 S4 – what year are you guys in *(looking around at other participants)* S3 & S2 – 3rd year	T4 – danger but there are possible dangers they need to be made aware of and you just follow it through with different types of T5 – hmm yeah T4 – animation, video whatever, but you are still framing the beginning but if you use video it's a lot easier than using animation, it's a lot less work for the developers using still frames, working with still frames T6 -so your opening scene could be someone in a car having a heart attack T3 – *indecipherable* T4 – or just lying next to the car T5 – yeah, too much hassle getting out of the car T3 – or are we already starting with something like the fears, students might have fears a couple of very short clips about students view of doing resuscitation in the first place

Storming is summarised by conflict and described by Tuckman (ibid) as an "emotional response to task demands" with conflict between the individuals about the objectives. Students spent significantly less time storming and only stormed on two occasions though tutors spent longer doing so and on nine occasions (see Table 4-4). The two very brief episodes of student-designer storming comprised discussion about current guidelines and the telephone call for help, with this significantly shorter time perhaps reflecting a focus on material provided at the workshop to guide their storyboard creation. The significant lack time spent storming by students

suggests there was more cohesion in the group and therefore more time available to move on to other stages, particularly performing in the design of the learning object.

In contrast, the tutor-designers spent a longer time and on more occasions storming, discussing how possible danger should be represented. This created debate between the tutor-designers and this conflict continued into other areas throughout the workshop. Tutors argued about professional responsibilities and whether advanced procedures should be depicted during the workshop, at 20, 36 and 45 minutes (see Box 3) interrupting the group's progression. Perhaps instinctively tutors referred back to their clinical knowledge and experience, forgetting they had been asked to work from published material. The irrelevant discussion and conflict between tutors was unnecessary as these issues are not part of the established knowledge in the material provided to guide the participants or part of Stages 1 and 2 in the Chain of Survival (see Section 1.4.2).

There was also discussion by the tutors whether more advanced assessments (the A to E assessment) or the management of advanced airway, in this case a person with a tracheostomy should be included in the learning object. There was animated discussion whether nursing students needed to know this information, at this early stage of their pre-registration nursing education and was only resolved when group reminded themselves of the objective of the workshop; to create a storyboard on how they believed established resuscitation knowledge was best represented in a learning object. When the tutors referred to the material provided at the start of the workshop, they identified the importance of representing the assessment of a collapsed adult and delivery of CPR was core to the learning object's design. By virtue of their clinical and academic experience, tutors may well possess additional knowledge of a topic whereas students are much less likely to and Kneebone & Nestel (2011) highlighted the development of expertise requires thoughtful and considered practice over time. However, the additional knowledge tutors possess may distract them from the principle objective of the storyboard workshop was to design a learning object on established knowledge for novice learners. In a broader context Walsh (2015) suggested the principles of product lifecycle management could be applied to curriculum design "…with different stakeholders – from learners to tutors to patients."

integral to developing a curriculum. In the design of learning objects, it is how established knowledge is best represented in the resource that is important. When only tutors are involved it may be their additional knowledge could distract them from the objective and reduce the time available during a storyboard creation workshop where as perhaps students are acutely focussed on the purpose of the learning object.

Because of the student-designers lack of clinical and academic experience, they did not possess additional knowledge that could have distracted them in the design of the storyboard. Tutors on the other hand who initially learnt resuscitation much longer ago and may have undertaken varying degrees of refresher education, may be distracted by this additional unnecessary knowledge hindering their progression to the performing stage when creating a storyboard. Consequently, the student–designers were able to focus on the purpose of the learning object and this can be summarised by saying they did not know what they did not need to know. The Johari Window model summarises this as an area of unknown activity, not known to self or to others (Sutherland 1995; Luft, 1982) and this may be an advantage when designing a learning object on established knowledge where material for designers to use is provided. It is how established knowledge is best represented in a learning object that is important and students may be much more attuned to other learners needs as they have acquired this knowledge much more recently.

Though learning object designers should feel able to raise concern over specific points, if these are irrelevant to the overall objective and dominate discussions they could hinder the group progressing on to norming and particularly performing stages. Tutors devoted time during the workshop debating a Registered Nurse's professional responsibilities until they reminded themselves nursing students are undertaking pre-registration education and have not yet entered a professional register.

Another possible explanation why tutors may be more susceptible to storming may be related to 'academic tribalism' (Becher & Trowell, 2001). Academic freedom is an important principle though there is a risk it could hinder the design of educational resources on established knowledge. Subject experts risk becoming ever more insular and focus on their own specialist field (Reisz, 2011), not only of a discipline but in a particular area

of that discipline. When designing learning objects for others to use acquiring established knowledge, those involved should base their work on material and guidance provided.

The inclusion of personal knowledge into the design may well enhance learning though first designers should ensure the established knowledge is integral to a learning object. Designers need to consider how knowledge is best acquired as well as what needs to be learnt, with small "bite-sized" chunks of learning preferred for pedagogical and design reasons (Wharrad & Windle, 2010). Retaining a focus to the overall aim of an exercise is important in achieving the task; a tutor's broader experience can add detail in a classroom though when designing a learning object for others to use acquiring established knowledge in a self-directed setting, designers should be encouraged to work primarily from the material provided. Tutors should only add professional experience if this makes a substantial contribution to the design discussions.

Box 3 – Storming(tutor-designers) [7]

Discussions about danger from 00:11:18 section

"so what picture are you envisage having in there to present danger" T2
"just somebody lying on the floor" T4
"on the floor, you know, you know" T1
"yeah but so what are the dangers … if I collapse now … where are your dangers if someone collapses in the supermarket" T2

"I am not trying to be too nit picky but obviously the emphasis now is start compressing the chest as soon as possible now if you are teaching people to spend sort of couple of minutes oh I better check there no gas coming out of there or whatever…" T2.

Discussion about professional responsibilities from 00:20:58 section

"yes I can see what you're saying but I'd debate whether that is something that needs to be thrown at them straight away…". T4

Discussion about advanced resuscitation assessments from 00:36:22 section

"err we have to be a bit careful how much are they they won't know what AVPU is…" T2

and

"no I did think about that" T5
"two algorithms down" T4
"but he asked us to do basic life support and I know I know" T5
"but it's a part of it though" T4

Discussion about advanced airways from 00:45:49 section

"well I think you might need to do that about the airway to be honest mention if they have a tracheostomy…" T3

The **norming** stage involves the "open exchange of relevant interpretations" (Tuckman 1965, p387) with discussion in the group how progress can be made in their task. Though students spent less time norming, the difference was not significant, with students' norming on seven occasions and tutors on eleven (Table 4-5) reflecting the more fragmented nature of the tutor group discussions (Visualisation Figure 4-2).

The similarities in the time both groups spent norming may reflect a high degree of collegiality from all participants working towards a common goal after volunteering to participate in this research project (Box 4). The original work by Tuckman made no claims as to the optimum time groups should spend in each stage so the value of applying Tuckman's model lies

[7] As there were only two brief comments classified as storming from the student–designers, these have not been included. The student participants' comment related to 1) which guidelines should be referred to and 2) when a call for help should be performed from a non-adult field participant.

in being able to compare groups to identify differences in how they function when designing a learning object. The norming stage where there is relevant discussion on the task differs from the performing stage where tangible work is achieved, though does set the foundation for a group to perform by allowing participants to test ideas and build group ownership. The risk of returning to the forming or storming stage may occur when group members refer to their previous experience and not the material provided. From the visualisation (Figure 4-2) tutors alternated between the norming and performing stages resulting in a more fragmented discussion, also highlighted by Palmgren-Neuvonen & Korkeamäki (2014) in their literature review. Norming appeared less important for the students though with a greater clinical knowledge and experience it appears tutors feel the need to refer back to this stage to validate their views. However, as both learning objects conferred significant knowledge acquisition, perhaps returning to the norming stage is less important.

Box 4 – Norming

Student	Tutor
S1- and then do a test after that umm if the patient or person was *audio from internet playing over background* like when would you do S6 – yeah S1 - and have to tick the one that were right S5 – we could do that like after doing the ABC S1 – yeah S5 because S3 – I think as well you know it gets a bit long, you should see each part – it's for A it's for B, and then it recaps everything at the end as every for using it for the first time you may lose track of what you're saying S1 yeah and what you're doing now S4 – yeah and what we doing general laughter from group	T4 we won't have cars T2 with shopping avocados T5 –we'll have retired when were 68 T2 – so there he is he's lying on the floor and she's there "help" and then you have "would you know …" or what would we say T1 – "would you know want to do T5 – you're a nurse, you should know what to do
S7 – straight away, a bit overwhelming S5 – yeah S7 – I think I'd like a little video not very long one S5 – yeah S7 - But one of basically what it is that you are going to be doing like a little visual think and going into ABC danger thing and then having something interactive afterwards S5 – yeah *some participants nodding agreement* S7 – maybe S1 – yeah definitely	T4 – so have we identified this is a case study to be followed through T2 – well it was a suggestion T4 – I think it sounds a good idea T3 – it gives it some context T5 – some structure *general agreement yeah, yeah from some group members* T1 – I think it a good idea T2 – pointing to T1 T1- yes I'm going to use these as I don't want to be on the floor for the entire time T2 – and we're all happy with the old man in the car park with the wife and its' kind of help turning to you

Performing is described by Tuckman (1965) as the emergence of solutions, where options are suggested and there is general agreement of their value among the group members, in contrast to the norming stage where there is group cohesion and testing of ideas by participants (see Box 5). Student-designers spent most time, a significantly longer time and on fewer occasions left the performing stage than tutor-designers did, allowing longer periods of productive work and less disruption to the discussions. Though tutors spent the second longest time in this stage they had many more interruptions (see Table 4-6) and this cyclical pattern is also apparent on the visualisation (Figure 4-2) that may indicate a focus on completing the task allocated, whether this was a conscious decision by the student-designers or not.

Jahng (2012) identified all groups entered the performing stage at different times though completed similar activities, with Johnson, Suriya, Yoon et al, (2002) previously identifying a similar picture, suggesting groups do progress to performing at different rates. The longer time spent by students in the performing stage of the storyboard workshop may be related to the student group focussing on the task they had been allocated and perhaps a stronger desire to design a learning object their peers could use?

One member of the tutor group did comment the students are likely to have taken a simple approach to this workshop saying

> "you can guarantee that the students will have kept it simple Participant" T5 from 00:55:05 section

There was agreement from T2 and silence for a few seconds from the group before T6 shared their thoughts on how this subject is taught.

> "I mean that is something I have been thinking about while you're talking cos you're thinking about how you teach it and then translate" Participant T6 from 00:55:05 section

Tutor-designers appear to realise later on in the storyboard workshop that they should focus on the material provided and identified the purpose with this particularly apparent on the visualisation (Figure 4-2) where the performing stages are visible in purple.

In education, the design of learning objects is a very new process that has occurred because of the Fourth Industrial Revolution discussed in section 1.2 and 1.3. It does not appear desirable to apply a classroom teaching approach to the design of a learning object to acquire established knowledge in a self-directed setting, as they are different methods of learning (see section 1.3). Tutors should work from material provided and determine how they thinks established knowledge is best represented in a learning object and that this occurs during the performing stage.

Students in the Fourth Industrial Revolution require a range of education approaches, including well designed learning objects. Laurillard (2008) identified it is not known how educational resources are developed and tutors, with a predominately classroom experience delivering learning and who were probably educated in this manner, may just transfer this method into a storyboard when designing a learning object, not considering the opportunities afforded by technology (Parisky & Boulay, 2013; Littlefield, Rubenstein & Pittman 2015). However, more interest in learning design is starting to address these issues (see Section 1.3.2) and pedagogy must drive the design of educational resources. It is essential tutors reflect on methods they use and include students where their contribution can enhance the design of learning objects novice learners can use to acquire established knowledge.

Box 5 – Performing

Student	Tutor
S5 – after doing the ABC because S3 – I think as well it gets a bit longer S1 – yes you think oh my god S3 – so you should see each part *describes the process over the video playing in background though general approval from S1, 2, 4 & 5.* S3 – otherwise you may lose track of it now S4 – you might think what do I do again *Group watching video and* S1 –this would be a good thing to do	T4 – here in your car park we would have T1 – cars, that's the main danger point isn't it T1 – yeah T3 – the main thing to think about is what you're going to kneel on, so make sure there is nothing to kneel on that is going to damage you T1 – yeah T2 – *slightly exasperated noise…* I suppose if you want to push the point you could have some broken glass out of his shopping basket T1 – yeah, no that's good so have the shopping T2 – yeah so that's it T1 – yeah so those two look great, so this is number two then so if we sorry if I write it then I can stick the picture to it can't we T2 – I think that's it really, you want to say overall "check for danger" T5 – yeah, yeah so as a big title yea that's good that I like that
S1 - Like the stadia S6 – How easy is it to do CPR S4 – yeah, yeah S1 – you could do it at the setting where … are we going to do it at a stadia, cos you could do it at the toilets at a football match or in a supermarket S6 – yes a supermarket You could do like the car park S3 – yes exactly S1 – and relate it back to the stadia S6 – you could make it really like relevant to *named city where research undertaken* like walking up *named street* S5 – or like the centre near the *named landmark* S7 – that actually happened the other week my field he's a student nurse had to go into the road and get him out of the road *general appreciative noises from group*	T1 – alright happy *pins material on wall chart* T3 –so do we have something in the text that says why the answers are right T1 – you could have an extra text box come up couldn't you so yeah here *get up to point at material on wall* right after drag *written on material on wall* T1 – I don't know how he's going to make sense of this

5.3.3 Why Use Tuckman's Stages of Group Development model?

This research applying Tuckman's model shows similar findings to Jahng (2012) who identified progress through the four stages was not linear or sequential and this effect was visible in both the student-designers and tutor-designers (see Visualisation Figure 4-2). There are differences in the frequency and time the student and the tutor group enter and spend in each stage and the original work by Tuckman (1965) was intended to identify the stages of a therapeutic, training and natural group's development, making no claim as to the optimal time that should be spent

in each stage. Wheelan et al (2003) large scale investigation of groups suggested the longer period of time a group spent together, the less dependency and conflict (forming and storming) and more work (norming and performing) statements were made, though both the student-designed and tutor-designed learning objects provided significant learning gains. Perhaps efficiency will be in the actual design of a learning object if groups working on storyboards are able to spend more time in productive stages of the process.

Logically sufficient but not too swift progression from forming to performing and then remaining in the performing stage would appear to be the most productive approach for a group task, though for a group to be most effective it may be necessary to spend time in each stage. The student-designers were able to spend most of the workshop time in the performing stage, with little interruption, whereas the tutor-designers took a longer period to enter the performing stage and even then spent shorter periods there (see Figure 4-2). In their investigation of online groups Johnson et al (2002) identified the forming stage was more difficult. Participants attributed this to not having face-to-face contact as they 'met' online over a number of weeks though for this research, the designers worked together. Additionally Johnson and colleagues found a lack of storming with participants identifying this and the initial forming stage as brief or non-existent perhaps due to the virtual contact, though where groups work in person a knowledge of the different stages by facilitators and designers could be instrumental to the success of a workshop.

In order to investigate differences in the way students and separately tutors function when designing learning resources, Tuckman's stages of group development model (Tuckman, 1965) was applied to the storyboard workshop video. It is a well-established model popular in management training providing a framework for trainers to explain how groups' function (Barr & Dowding, 2012; Hutchings, Hall & Lovelady, 2004), in empirical research (Jahng, 2012; Johnson et al, 2002) in online learning (Palmgren-Neuvonen & Korkeamäki, 2014), in primary school children learning (Walker & Mathers, 2004) and General Practitioner prescribing).

Instead of applying a model to analyse the behaviour of each group during the storyboard workshop the participants discussions could have been

transcribed and a thematic analysis undertaken to identify what participants discussed as undertaken by Palmgren-Neuvonen & Korkeamäki (2014). Their work investigated the transcriptions of five primary school children storyboard discussion of a school project with the difficulties coding 84 minutes of video noted as a limitation. As this study involved reviewing much more data (13 participants in two groups with their discussions lasting over two hours each) replicating Palmgren-Neuvonen & Korkeamäki (2014) approach would have been unmanageable. Using behavioural analysis software and applying Tuckman's model to the video allowed a comparison of each groups' actions and with the simplicity of Tuckman's model highlighted by Schuman (2001), a picture of howthe student-designers and tutor-designers functioned and what pedagogical decision were made when designing a learning object emerged.

Wheelan, Davidson and Tilin (2003) did employ qualitative methods to validate Tuckman's model in their large scale (114 groups, n=819 participants) study. Trained raters applied a group development analysis tool developed by the authors based on group theory literature by Bion (1961) to transcriptions of meetings and when combined with a follow up questionnaire, confirmed a sequential group development model such as Tuckman's can be used to explain how groups function. The limitations of research undertaken in the field were noted though the authors argue small-scale laboratory type studies may not be representative of the wider population either and more natural experiments, such as this investigation into how students andseparately tutors design learning objects, will help understand how educational resources are designed and made more effective.

Other models such as one described by Gersick (1988) referred to as a Punctuated Equilibrium model and Tubbs (2004) systems approach to small group interactions could have been applied though there is criticism of Gersick work highlighted by Wheelan et al (2003) due to small sample sizes and a lack of a theoretical basis for claims made. Efforts to amalgamate features of all approaches into an overarching model by Hurt & Trombley (2004) unnecessarily over complicate the methodology and all appear to draw from Tuckman's original work. An investigation by Jahng (2012) applying Tuckman and Gersick's models to explain how six groups functioned on a problem solving task as part of a graduate online course

suggested Gersick's model would be more helpful in explaining behaviour, though the groups were studied over six weeks not a morning workshop as in this work. An earlier study by Johnson et al (2002) investigating team development of master's students' over a number of weeks suggested Tuckman not Gersick's model better explained how the group developed and perhaps either model could have been applied to this investigation's data. Consequently as other models (Gersick, Tubbs, Hurt & Trombley) draw at least in part from Tuckman's original work, his group development model was adopted for this investigation.

5.4 Storyboard Workshop and Pedagogical Factors

5.4.1 Understanding the Pedagogical Factors Discussed

The rapid development of digital educational resources makes the use of validated pedagogical evaluation tools essential if online education is to command respect. There appears a lack of well-designed studies comparing traditional and digital learning as Dolan et al (2015) and McCormick & Li (2006) highlight and this paucity of pedagogical research identified by Torgersen & Torgersen (2001) continues today (Anon, 2016b). Laurillard (2012) argued teaching should be viewed as a design science similar to engineering and therefore investigated in a similar manner, with the online LOAM Tool (LOAM, 2014) developed from Windle et al (2007) work (see Section 3.1 & 3.1.4.2) to understand what pedagogical factors are represented in a learning object. This deficit in educational research may be ascribed to there being no one method for educators to design, develop and evaluate educational interventions with disciplines following approaches common to their practice though is being addressed and recent work developing a standard methodology to evaluate educational interventions (Phillips et al 2016 & Section 1.3.3 & 2.3). By adopting a rigorous approach when investigating educational practice, researchers will be able to contribute to an evidence base identifying effective interventions, informing the wider academic population what interventions show promise.

The Learning Object Attributes Metric (LOAM) Tool developed by Windle et al (2007) is based on IMS Learning Design principles (IMS Global Learning Consortium, 2003) and its' pedagogical design theory supports the use in this research. By classifying a group's discussion of pedagogical factors

during a storyboard workshop, an understanding of what was discussed can be gained. With the same process applied to another group, comparisons can be made identifying similarities and differences in the time spent, though a longer time spent discussing a pedagogical factor could be interpreted as participants ascribing importance or grappling to understand that concept. A possible solution could be to inform learning object designers of the LOAM Tool at the commencement of a workshop and is discussed in Chapter 6 (see Figure 6-1 and Appendix 8-14).

The application of the LOAM Tool to future storyboard workshops in the design of other learning objects on established knowledge could provide additional data to identify pedagogical factors that appear important to designers. However, at this exploratory stage it is the application of the LOAM Tool that has been identified as a possible approach to understanding what factors groups believe important in the design process.

5.4.1.1 Activity

Activity refers to what the learner is asked to do when using a learning object such as entering text or answers to a quiz or selecting and moving images. Of the four pedagogical factors listed under the LOAM Activity sub-heading, students discussed for a significantly longer time than tutors how users would *navigate* a learning object. There was no significant difference in the time students or tutors spent discussing *assessment* or *interactivity* and neither group discussed the *alignment* of the resource.

It may be tutors assumed students are *au fait* with how to navigate digital resources though whether this is actually the case is unknown (Leaver, 2012). This aspect of learning object design should not be overlooked as a) students do not necessarily possess computer technology skills (Ballantine, McCourt-Larres and Oyelere, 2007; Bond, 2004; 2010; Kennedy et al, 2010) and b) RLOs can be used by a much broader audience. In the light of this, it is worth highlighting to designers they should considered how learners use a resource as this may enhance the acquisition of knowledge and the acceptability of a learning object. By paying attention to this detail it may be the cognitive load on the student was reduced (Sweller 1988) and explain why the difference in confidence in knowledge was significantly enhanced in the student-designed learning object (see section 5.2.2). In the post viewing evaluation participants' specifically commented positively

on navigation and interactivity aspects, with very little said about assessment or alignment of the resource viewed (Tables 4-17 to 4-20). Navigation discussions featured significantly more highly in the student-designer than tutor-designer discussions suggesting tutors may assume students in the Information Age will know how to navigate around an RLO though this may not be the case. Just because a student possesses a smart phone, tablet, laptop or a desktop computer and is intimately acquainted with a plethora of social media applications does not mean they can apply this knowledge to their education (Kennedy, Judd, Dalgarnot & Waycott, 2010; Holmes, 2011) though tutors appear to be in a similar position (Kennedy, Kruase, Gray, et al 2006).

The interactivity and assessment factors were equally commented on by the participants in the evaluation whether they viewed the student-designed or tutor-designed learning object and afforded a similar importance during the storyboard design. Interaction and self-assessment are required for active learning where dialogues between students and tutors occur (Laurillard 2012; Petty 2010) whether this is facilitated by digital resources in an asynchronous manner or direct student/tutor interactions. Perhaps both groups of designers decided interactivity was implicit as they had been asked to design a digital learning resource though an explicit direction for designers may reduce possible misunderstanding what interactivity actually involves. Kay and Knaack (2008) research developing a learning object analysis tool identified a plethora of literature relating to interactivity, suggesting learners engaging with a resource and possessing sufficient control is important to the user. Learning and Evaluation (phase 2) participants in this investigation irrespective of the learning object assigned appreciated interactivity (Table 4-17, *"Being interactive helps to learn the information"* and Table 4-18 *"The interactive aspect…"*) and designers should include these aspect without overwhelming the learner as this may risk cognitive overload (Sweller, 1988 and see Section 5.2.2).

By undertaking activities, learners may achieve a deeper engagement with their learning and technology opens up opportunities for this to occur in a far more diverse manner than when using non-digital resources (Laurillard 2008). Ramsden (2003) has identified the engagement of students as necessary for effective learning in a traditional education environment and

transferring this to an online environment such as that provided by a learning object appears logical. A didactic lecture delivered in a monotone style is unlikely to retain the interest of students compared to a lecture interspersed with activities (small group discussion, buzz groups, quizzes employing audience response tools, viewing a video clip). A traditional lecture still has limitations in inexperienced hands (Fry et al 2009) and the interactivity learning objects offer should be exploited to enhance a learner's experience.

Designers of learning objects should ensure discussion of Activity pedagogical factors is part of the design process. It may be helpful if instructions in the LOAM Tool clarify whether formative or summative assessments are the focus, as the word assessment does imply being judged with the contribution it can make to student learning contested in higher education (Fry et al., 2009). Biggs and Tang (2011) highlight there are a number of reasons why students are assessed including selection, control and public expectations suggesting there is a difference between 'formative feedback' and 'summative grading' (ibid, p195). When designing small short learning resources the amount of learning that can be assessed is likely to be limited and the inclusion by designers of formative feedback perhaps what should be promoted.

The absence of discussion around alignment by either group may be linked with the assessment discussions and an assumption because the purpose of the resource was closely specified at the very start (a learning object for novice nursing students to learn essential resuscitation knowledge) this factor was unimportant. However the concept of constructive alignment (Biggs and Tang, 2011) where assessment reflects the learning undertaken is worth highlighting to designers, even if only formative and not summative assessments are included as education should support the learning aim of a resource.

5.4.1.2 Environment

The LOAM Tool interpretation of IMS Learning Design describes the learning environment consisting of the following pedagogical factors; *media richness*, the *context*, how *integrated* the media is and the match between the content and *objective* of the resource. In a traditional classroom the learning environment is a physical space though with learning objects this

refers to how media is used with-in the resource and the actual physical environment where and when the RLO is used in the control of the learner. The most important pedagogical factor to both groups by time was the objective with tutors spending significantly longer than students discussing this factor. There was no significant difference in the time spent discussing integration though both allotted this the second longest time period suggesting they considered it important. There was minimal discussion of media-richness or context pedagogical factors by both groups.

The environment where learning occurs is integral to its effectiveness when face-to-face education occurs, with simple but essential considerations of space, light and resources required (Thistlethwaite, 2010). Clearly, a digital resource has a very different environment with the learner exerting much control over physical elements where they will learn, though the designer makes decisions about the virtual environment before the resource is completed. Designers of RLOs should be made aware of cognitive load theory by Sweller (1988) so they do not over burden learners whilst still providing a sufficient cognitive challenge. Where a student will learn using an RLO in a virtual environment appears important to the participants with much evaluation free text comment relating to Environment pedagogical factors and the use of media (Table 4-17 to 4-20). A small number of participants irrespective which learning object was viewed commented on technical aspects of the audio, highlighting the quality recorded and the avoidance of a monotone voice is important; designers should be made aware of these issues so they can be considered in the design process.

Both groups' spent most time discussing the objective despite what was thought to be clear guidance from the researchers prior to and at the start of the storyboard workshop. However, why tutors spent significantly longer discussing the objective may be related to academics promoting their own field of expertise and 'academic tribalism' (Becher and Trowell, 2001; Sternberg, 2014) discussed earlier in section 5.3.2 influencing their deliberations or a desire to ensure all involved understand the broad intended outcomes of a storyboard workshop. Whilst it is important to have a clear objective in mind, the exact detail may be less necessary at the storyboard stage as by following the Agile Development Method (Figure 3-2) there are review stages built into the process, both before and after a storyboard workshop (Boyle et al, 2006; Wharrad and Windle, 2010).

Facilitators of storyboard workshops must be aware of a desire for absolute clarity in agreeing the objective is likely to reduce the time available to discuss other pedagogical factors and may interrupt the fluent functioning of the group when designing a learning object on established knowledge. To attenuate this the facilitator should ensure the objective is clear at the start and may have to remind the participants during workshop to refocus their efforts on other aspects of the design and not just the objective of the learning object. It appears defining the objective of an learning object and ensuring there is a clear, strong link with the content is essential, and if this concept can be more explicit for designers, the design process may be more efficient.

The goal of the student-designed and tutor-designed resource was for novice nursing students to use the learning object to acquire established resuscitation knowledge. The integration of media in the design of a learning object is central to the achievement of the goal as technology allows this opportunity, though designers should not be concerned with technical aspects of this process; that is for the developers to address as designers should concentrate on how they believe established knowledge is most effectively represented in the resource. Both groups allocated the second longest time to this factor discussing how media was best included in the resources and links to the interactivity factor discussed above.

The use of media in learning resources provides opportunities not widely available even a generation ago, though Laurillard (2008) argues these have not been as widely exploited as they could be. A brief search for literature used in education identified the use of media as a well reported area; when the search was limited to the health professions there were many suggestions how video could be used (Corbally, 2005; McKenny, 2011) and an evaluation by Hurst (2016) reporting video podcasting to learn clinical skills at Kirkpatrick's reaction level. However, caution is wise as the results of Duncan et al (2013) indicated the quality of clinical skills videos on You Tube™ left much to be desired. If the aphorism of a picture representing a thousand words is true then a video should be able to convey even more information, as long as it is relevant and appropriately integrated into a learning resource.

Though both groups used a short (two-minute) video, the student designers decided this should be displayed at the start of the learning object. This meant the learner will first view the practical application of the knowledge followed by clips from the video illustrating the assessment and resuscitation of an adult before replaying the whole video a second time at the end. The student approach closely mimics the four stage skill teaching approach recommended by Peyton (1998) though the tutors decided the learner should just view the video at the end of the learning object. Some participants questioned the need to repeat the video (Table 4-18 *"…I don't think it needed to be played through three times."*) in the student-designed resource though the positive comment about the inclusion of video (Table 4-16 & 4-17) in both learning objects outweighed these views and may be explained by different students learning styles. Whilst it is not possible from this research to state whether a student-designed or a tutor-designed learning object can meet different students learning needs, following established educational principles appears sensible as even the concept of learning styles is contested (Biggs & Tang 2011; Fry et al 2009). Designers should be directed to suggest how they believe established knowledge is best represented in a learning object, with developers then interpreting the designers' requests.

Whilst there was little discussion of media richness itself, the integration of this media was considered highly important, ranked second to objective by both groups, corresponding with Windle et al (2007) finding a correlation between objective and integration pedagogical factors in the development of the LOAM Tool. How media is integrated into a learning object may be important in Sweller's (1988) cognitive load theory, highlighting designers' should produce a resource sufficiently but not excessively demanding. The lack of discussion about the media perhaps reflects the initial instructions to both groups not to concern themselves with the detail (e.g. images, audio, video) of learning objects they wished to include, as this was for the researcher to address after the Storyboard Workshop (phase 1).

5.4.1.3 Roles

There are fewer roles a learner can assume in the LOAM Tool interpretation of the IMS Learning Design and this is apparent as least time is ascribed to the discussion of *self-direction, feedback, support* and *pre-requisites* pedagogical factors by the student-designers and the tutor-designers. This

research investigated the teacher role played by an RLO (see Section 5.1) and demonstrated a student-designed resource can be as and even more effective than one designed by tutors. No significant difference was identified in the discussion of feedback, with students and tutors designers assigning most time to this pedagogical factor ranking it third and fifth respectively (Figure 4-5). The other three pedagogical factors (self-direction, support and pre-requisites) were considered as less important by the participants as they attracted minimal workshop time. Perhaps students expect to be directed in their learning and tutors expect student to be accustom to using digital resources, with these views permeating both groups' design decisions?

Designers of learning resources need to be aware of how much text to include and how quickly the learner has to read this with comment on both the student designed (Table 4-18) *"the amount of text in each speech bubble"* & *"couldn't read the information quick enough"* and tutor designed (Table 4-19) *"not always able to read information on the side while video was being shown"* & *"with the audio slow for writing to come up sometimes"* learning object. Sweller's (1988) cognitive load theory identified the importance of the intrinsic, extraneous and germane load concepts along with how learners need to develop an effective schema to organise their learning. A learner has little influence on the curriculum and cannot adjust the intrinsic load though tutors decisions affect the extraneous and indirectly the germane load by determining the amount and how additional information is presented to the learner.

Participants in this research identified too much information presented quickly was unwelcome, supporting the development of a number of smaller complementary "bite-sized" resources (Littlejohn and Peglar, 2007; Wharrad & Windle, 2010; Windle, McCormick, Dandrea & Wharrad 2011). A decade earlier Wharrad, Kent, Allcock & Wood (2001) investigation of nursing students using computer packages to learn cell biology reported participants liked instant feedback and shorter packages suggesting designers should pay close attention to these aspects.

Evidence of the beneficial influence cognitive load theory has in the development of an e-learning resource is visible in research by McMullan et al (2011) who demonstrated a significant improvement in knowledge and

the acceptability of an e-learning package when compared to traditional instruction on medicine calculation. Handley & Handley (1998) demonstrated the benefit of simplifying initial basic life support skill education for the layperson by describing the adoption of a simple sequenced structure. Novice nursing students could be considered of similar ability to this population and addressing the cognitive load when acquiring established knowledge applicable to other areas of learning. Nolan, Hazinski, Billi, et al (2010) reporting the 2010 Resuscitation Guidelines discuss educational approaches and the 2015 Resuscitation Guidelines Education published by the American Heart Association (2015) specifically identify core educational concepts including the simplification of content and presentation in resuscitation teaching. The support required by a user is listed under role and though there was little discussion of this factor by students, tutors ignored it completely again perhaps suggesting tutors assume students know how to use RLOs already discussed (see 5.4.1.1).

5.4.2 Alternatives Ways of Evaluating Learning Objects

An alternative instrument that could have been used was the Learning Object Evaluation Metric (LOEM) (Kay and Knaack, 2008). Kay and Knaack validated their tool by applying principal component analysis to a large data set gathered from school students and teachers use of predominately mathematics and science learning objects[8] selected by the teachers. The tool[9] included 17 variables[10] resulting in a range of possible score from 17 to 51 for each RLO across four main headings (interactivity, design, engagement and usability) with content identified in the literature included in interactivity though apart from the LOAM and LOEM Tools there is a lack of robust instruments with a sound theoretical basis that can be used to evaluate learning objects. Efforts by a number of e-learning experts including the Valkenburg Group to address this deficit (Koper & Tattersall 2005) appear not to have gained traction and the web address (www.valkenburggroup.org) referred to by Dean, Guo, Jun et al (2005) does not now appear valid. An internet search (Google and Bing, 25 June

[8] http://faculty.uoit.ca/kay/res/AppendixC.html

[9] http://faculty.uoit.ca/kay/res/AppendixB.html

[10] http://faculty.uoit.ca/kay/res/AppendixA.html

2016) did not reveal any trace of the organisation and the Web of Science revealed 46 results, though when refined to include computer and education, the 13 results were not relevant. A final search of the University of Nottingham library database identified seven papers in the first decade of the twenty-first century, though they only included minor comment or the Valkenberg Group noted in reference list entries.

A number of frameworks to guide designers of online resources have been suggested though these reflect common practice rather than being based on theoretical foundations (Conole, Dyke, Oliver & Searle 2004) with Attwell (2006) and more recently Friesen, Gourlay & Oliver, (2014) also identifying the lack of research into e-learning pedagogy. Even a decade on though assessment tools are available (Bremer, 2012; California State University, 2016) many appear to lack strong theoretical foundations and it may be given the relatively early stages of technology enhanced education, pedagogical research methodologies are at an embryonic stage.
There are common threads in the LOEM and LOAM Tool such as how users navigate and interact with a digital resource, the media used and how feedback is provided, though other aspects including assessment, context, self-direction and support derived from the IMS Learning Design theory do not appear represented in LOEM. Jochems, van Merriëboer & Koper (2004) argue for common standards in the development of e-learning and promote this by engaging key actors in the field with the Larnaca Declaration (Dalziel, et al 2016) suggesting this has been identified as necessary for digital learning to advance. Consequently using the LOAM Tool as a framework to analyse the storyboard design process provides a sounds basis for this work contributing to what is already known about the design of learning objects and the potential benefits promoting student designed resources used to acquire established knowledge.

6 Conclusions

The results of this investigation demonstrated findings relating to the effectiveness of learning objects used to acquire established knowledge and the design process when creating these types of educational resource for use in higher education. These finding may be useful for designers of learning objects used by pre-registration nursing students and potentially other healthcare students. Indeed, they may also be applicable to learners in non-healthcare disciplines for the acquisition of essential knowledge and in the wider community, where users could make a significant contribution to the design of a resource for patient education in the healthcare environment.

First, participants who viewed the student-designed or the tutor-designed learning object significantly improved their knowledge and confidence in their knowledge from viewing the resource and both resources, again regardless of designers were evaluated highly by the learners. This finding demonstrated that RLOs are effective when used by novice students in a self-directed learning setting.

Secondly, a student-designed learning object on established knowledge conferred additional learning gains, as there was a significant difference in confidence in knowledge, favouring the resource designed by students. One possible explanation for this finding is that students are more attuned than tutors to their peers learning needs and are more cognisant of including aspects that enhance, or avoiding aspects that hinder the acquisition of knowledge in the design of learning objects. Ultimately, the student-designed RLO was able to confer a great level of confidence in knowledge to the learners who accessed this resource.

Finally, the student-designers and tutor-designers were able to design their respective learning objects following the Agile Development Methodology (Boyle et al, 2006; Wharrad and Windle, 2010) with the storyboard workshop recorded for this investigation to enable the researcher to evaluate how student and separately how tutor designers function and what pedagogical factors they discuss, when working as a small group.

When the student and tutor designers were observed under the lens of Tuckman's stages of group development model (Tuckman, 1965), each group functioned differently and though they both achieved a learning object design that was effective, differences were evident in how each group functioned during the storyboard creation workshop. Student-designers spent significantly more time performing and significantly less time storming and this may be a result of students having to focus on material provided for a storyboard workshop because of their lack of experience of resuscitation and not refer to additional knowledge gained from clinical and academic knowledge and experience, as tutors appeared to do. In the design of a learning object to acquire established knowledge, designers should focus primarily on established knowledge material provided and avoid being distracted by additional professional experience, unless they are very confident this will add to the learning object design.

Then the Learning Object Attributes Metric (LOAM) Tool was applied to understand what pedagogical factors the designers discussed during the storyboard workshop. Though many similarities in what pedagogical factors were discussed and for how long was observed, there were two notable exceptions. Student-designers spent significantly longer discussing navigation than tutor-designers did and this may be due to an assumption students currently in higher education are familiar with learning objects. Whilst technology pervades the personal and educational life of students in the Information Age, an assumption that students are familiar with how to navigate around a learning object may not be true for all students (Holmes, 2011). The second difference was that tutor-designers spent significantly longer discussing the objective of the learning object. The reason why this may have occurred could be related to the earlier discussion around tutors being distracted by their additional clinical and academic experience, rather than focussing on the material provided for a storyboard workshop, reinforcing the need to provide unambiguous instructions for learning object designers at the start of a storyboard creation workshop.

Both student-designers and tutor-designers have a valuable contribution to make in the design of learning object, though facilitators of learning object design projects should ensure designers are aware of group dynamic and pedagogical factor theories. Knowledge of these theories may enhance the efficiency of the Agile Development Method (Boyle et al, 2006; Wharrad

and Windle, 2010) learning object design methodology and could be achieved by explaining Tuckman's stages of group development theory and the LOAM Tool pedagogical factors to designers prior to a storyboard workshop (Figure 6-1). A simple guide, based on the underpinning theory of Tuckman's model and the LOAM Tool, made available to designers and included in the Agile Development Method combined with a short presentation to at the start of a storyboard workshop, could enhance the learning object design process (see Appendix 8-14).

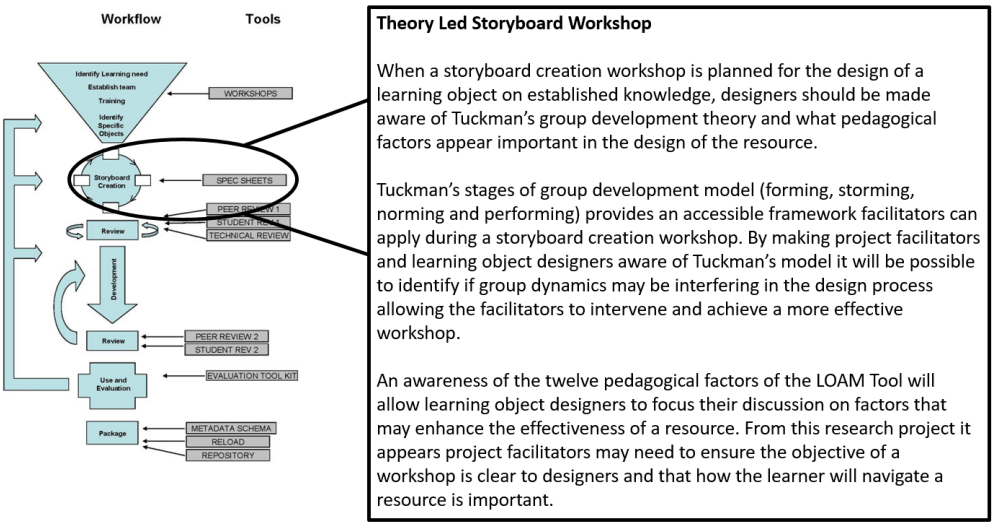


Figure 6-1 Agile Development Method Theory Led Storyboard Creation
Figure 6-1 shows the additional focus on the storyboard creation workshop recommending facilitators and designers are made aware of Tuckman's stages of group development allows all involved to ensure the group is functioning as effectively as possible and intervene if necessary, when designing a learning object used to acquire established knowledge

6.1 Tangible Result of this Research

This work demonstrated it is possible to apply Tuckman's stages of group development model (Tuckman, 1965) to a storyboard creation workshop to better understand how homogenous groups of designers function during this process and why designers should be cognisant of the twelve pedagogical factors described in the Learning Object Attributes Metric tool (Windle et al, 2007). Facilitators and designers involved in projects to design learning objects for novice students to learn established knowledge should follow an Agile Development Method (Boyle et al, 2006; Wharrad and Windle, 2010) with students integral to the design team, not only in the review stage, but in the storyboard design. In projects to develop learning objects for student to use acquiring established knowledge, facilitators should ensure students are integral in the design of a learning object and enable the primacy of students role in the design process,

whether they are working with other groups (e.g. tutors) or not. They should be aware of how group dynamics can intefere with progress during the storyboard creation process and if necessary can intervene and refocussed the designers to the objective of the work making better use of the time available.

There are three tangible result of this research. Firstly, RLO designers and facilitators should be cognisant of Tuckman's stages of group development so they can work as a group and identify early on if there are barriers to they work. Secondly, designers should be aware of LOAM Tool pedagogical factors during the storyboard creation workshop so learning objects are pedagogically, and not technologically led, with appendix 8.14 a resource for project facilitators to use. In addition, designers should work from material provided by the facilitators of a project to design a learning object for student to use acquiring established knowledge. Finally and most importantly, the inclusion of students in the design of a learning object novice students can use to acquire established knowledge appears to enhance the learning gains achieved, because they are pedagogically closer to the learner and more able to align the design to novice learners needs and these points are summarised below.

6.2 Technology, Learning and Learners

6.2.1 Technology

The impact technology has had on society is unquestionable with the Fourth Industrial Revolution encapsulating the changes that have, in a short space of time, already occurred. How these changes will go on to affect society is unknown, though the impact on society is inescapable and education is not immune to these effects. The technological advances in telephony or personal computing over the last 30 years has been exponential, with mobile phones once the preserve of the wealthy, are now commonplace with the Living Cost and Food Survey (Office for National Statistics, 2017) reporting 95% of households can access a mobile phone. In a similar manner, the accessibility of computing power that little more than a generation ago in the twentieth century was controlled by large organisations (companies, universities, governments) is now available to the individual and at a fraction of the cost. The Office for National

Statistics, (2017) reported 88% of households in the UK can access a computer and the Internet, with education also experiencing these effects, whatever ones view may be of this change in society (Sundgren, 2017).

6.2.2 **Learning and Learners**

Learning and learners have also metamorphosed over time though not necessarily at the same rate. Learning has occurred since the dawn of time though theories to understand how humans learn a more recent interest evolving into a distinct discipline in its own right. The psychological processes that enable learning to occur have been investigated in the latter part of the nineteenth century and they continue to be investigated today, with learning theories reflecting the technology available at that time. Learners have also evolved over time, with compulsory education for children in the UK developed to serve the Second Industrial Revolution where a workforce with some education was necessary for the factories and mechanised society of the time. In recent decades, education as a right has emerged, at least in developed societies and when considered as an individual's human right explains why learners in the Fourth Industrial Revolution and the Information Age can and should play a more active role in education.

The design of educational interventions, whether this is curricula or resources for learning is less well understood. Traditionally tutors have designed educational resources and programmes based on a transmission educational model. Even when tutors develop digital educational resources, a traditional approach has been applied in the design process. The design of learning objects, the focus of this investigation, is also less well understood, though given the lack of attention to educational research, is hardly surprising. However, there are moves to address this deficit with Helen Beetham, Graninne Conole, Dianne Laurillard, Martin Oliver, Richard Windle and Heather Wharrad (Beetham & Sharpe, 2013: Conole, 2013; Laurillard, 2008/2012; Oliver, 2010; Windle & Wharrad, 2010) among others investigating the design of learning in the Information Age.

When students are involved in the design process, new possibilities can emerge because they are not encumbered by traditional approaches to education and have experience of the opportunities technology provides. In addition, as a student-designer, they will have learnt this established

knowledge much more recently than a tutor will. In Vygotsky's language, they are much closer to the learners experience and therefore better positioned to understand how established knowledge is best represented in a learning object and be more accessible to a novice student.

The wider changes in education discussed above can also be seen in the nursing profession. An apprenticeship model was initially adopted for pre-registration nurse training and only more recently (depending on the country) was nurse education moved to the higher education sector in the latter part of the twentieth century (Honey & Proctor, 2017). Honey and Proctor go on to identify in the Information Age it is more important to know where and how to find knowledge, though as well as being accessible, content in educational resources used by students, whether for the nursing or another profession, must be credible. Knowing how to resuscitate an individual who has collapsed is essential for any nursing or health professional student, though the effective performance of this skill is dependent on the student first acquiring the established knowledge. Resuscitation knowledge has not been effectively acquired by nursing students though whether that is because of the sub-optimal design of educational resources or poor instruction is unclear and in any case inconsequential as the effect is the same. It is probably a result of both deficiencies and a student-designed learning object appears to enhance a novice student's learning because the designer has much more recent experience of learning resuscitation knowledge. In addition, the tutor role is performed by the learning object, allowing the content to be standardised and of a known quality when a robust methodology such as the Agile Development Method (Boyle et al, 2006; Wharrad and Windle, 2010) for the production of a learning object is adopted. When learning established knowledge the novice student can easily repeat the learning encounter by replaying the learning object at a time and place of their choosing and they have more control over their own learning.

6.3 Concluding Thoughts

The results of this research not only demonstrated learning objects achieved significantly enhanced knowledge acquisition, but also that a student-designed resource significantly enhanced the confidence students had in their learning. Tutors commonly design educational resources in isolation as part of an overarching curriculum, in stark contrast to the

methodology used when resuscitation guidelines are developed and agreed (see section 1.4.3 & ILCOR, 2017), and even though a student focus to education is more visible, tutors need to deliver what students want to learn, rather than what the tutor wishes to teach (Norton, 2009). Student-designed resources appear more aligned to a novice student's needs perhaps because students have learnt this established knowledge much more recently than tutors did and this exploratory research uncovered more detail in the learning objects design process and how these types of resource can confer greater learning of established knowledge.

Universities and other educational establishments should consider how the results of this work could influence the design and delivery of education as this work demonstrates why the student voice in the design of education is important. A comprehensive digital learning strategy comprises a range of activities from learning objects to activity models (see Figure 1-4, Oliver 2007) and requires time, finance, intellectual capital, a suitable environment and motivation, though if the educational resources are of poor quality the learning achieved will be sub-optimal. And learning object not only need to be well-designed but shown to be achieve learning gain. As Judith Finn suggested in an editorial in *Resuscitation*, just because students like e-learning does not necessarily mean it is effective (Finn, 2010). In this investigation, the student-designed and tutor-designed learning objects conferred learning gains and both resources allowed users to achieve a greater confidence in their knowledge. However those viewing the student-designed learning object achieved a significantly greater confidence in their knowledge than those who viewed the tutor-designed resource, supporting the theory that students are best placed to design learning objects on established resuscitation knowledge for other nursing students to use.

The student holds much more control over how and when they learn using an RLO than when learning from a tutor in a classroom and a high degree of control may enhance their engagement and satisfaction with the educational experience. A view only tutors can design a learning object devalues the contribution students can make to the design of resources and is inconsistent with a social constructivist approach to education.

Any evaluation should included all four Kirkpatrick levels (reaction, learning, behaviour and organisation results) though may be restricted by the size of a project. However, any evaluation should include more than just an assessment of participants' reaction if a reliable evidence base of educational interventions is to be developed. To evaluate user's reactions when they use a learning object provides evidence of acceptability of this type of educational resource though an objective measure of knowledge acquisition will provide stronger evidence. And without robust evidence of learning gains, the advantage learning objects can confer to education will remain unknown.

The deployment of digital learning resources made widely available on or off campus through the use of technology provides consistency for all who can access that learning object and allows the resource to be updated. Moreover, by making educational resources more accessible a diverse range of learners can access a resource which may also enhance student participation. With resuscitation guidelines reviewed on a regular cycle by the international Liaison Committee on Resuscitation (ILCOR, 2017) and disseminated through regional and national resuscitation member organisations, universities and other education providers who adopt this guidance can be confident in the accuracy of the content. Well-designed learning objects will ease the maintenance and updating of the resource with less effort than a paper based system, though there will be a requirement for designer and developer time to maintain and update the digital architecture supporting learning as these are not simple systems (Thomas & Richards, 2012). However updating RLOs promptly to reflect new guidelines will minimises the use of out-dated learning material that could result in poor clinical practice and professional, regulatory or even legal sanctions and reputational damage to the University that ultimately could harm a patient.

Having demonstrated the value of a learning object to acquire established resuscitation knowledge this approach could be applied to other clinical skills learning where there is an established knowledge base and with other health professional students. In addition, the findings from this work will not be limited to the nursing profession as every academic discipline has established knowledge involving the acquisition of essential information; anatomy, biological processes, fundamental science and history are

examples where student-designed learning objects could confer additional learning gains for novice students.

The results of this work could also be applied to the broader health community as coproduction and ensuring the patient is central to the design of their care is assuming greater importance (Coulter, Roberts & Dixon, 2015; Batalden, Batalden, Margolis, et al 2016). Expert patients' may be best placed to determine how established knowledge about their care is most effectively and efficiently conveyed in a learning object and to influence the design they must be involved from the very start of a project. It is important to understand the boundaries of this research as it investigates how educational resource designers believe establish knowledge is best translated into a learning object for others to learn from. However, the Fourth Industrial Revolution presents possible solutions unimaginable little more than a generation ago, where well-designed learning objects can enhance student learning, and all involved in education must grasp this opportunity.

6.4 Limitations

There are four main limitations to this research; 1) the size of the study and timescale it was undertaken over 2) the interpretation of the Tuckman model and LOAM Tool descriptors are based on the interpretations of the author, 3) the learning and evaluation sample was underpowered and 4) the development of the learning objects by the researcher could introduce bias. Each limitation is discussed with an explanation of how the results may be affected and the measures taken to minimise the effects. Despite these limitations, this investigation in to student-designed and tutor-designed learning objects informs pedagogical practice in the Information Age and with the opportunities and demands of education in the twenty-first century, is necessary.

6.4.1 The Study Size and Timescale

This work was undertaken by the author with the support of two supervisors towards part-time doctoral studies with constraints of time and resource ever present. Including additional groups of student and tutor designers and undertaking data collection over a longer timescale could have allowed an evaluation of knowledge retention or investigated the

practical application of knowledge. This could have allowed additional Kirkpatrick Evaluation Levels to be assessed but was not feasible though this exploratory work reveals insight into how learning objects are designed and their contribution to student learning.

6.4.2 Interpretation of Tuckman and LOAM

How the Tuckman stages of group development framework and LOAM Tool descriptors were interpreted may have introduce bias though was based on objective descriptors from the original literature (see Appendix 8.11 & 8.12). An effort to enhance the reliability of the video interpretation was made by asking an independent e-learning researcher (rater B) to follow the same process as the researcher (rater A) applying the Tuckman model and LOAM Tool to short sections of the video (see section 4.1.1) and a pre-planned structured approach to the data collection and analysis was followed.

The observations between the raters indicated a low reliability of the observation and further discussion between the raters may have been useful to ensure the descriptors for both models were accurately interpreted. The use of a reliability function with in the Observer software would have enhanced the process of confirming the reliability of the storyboard workshop (phase 1) data. However, the exploratory nature of this study will inform others planning similar approaches and in future work more attention will be directed to strengthening this aspect.

In addition, the time spent by each group discussing pedagogical factors has been interpreted as the relative importance the group ascribed to each factor though an alternative explanation is they required more time to understand this aspect. Future research interviewing designers could explore these aspects in more detail and combined with strengthening the interpretation of the Tuckman and LOAM Tool descriptors, enhance the reliability of future studies.

6.4.3 Learning and Evaluation (phase 2) Sample

Because novice nursing students participants receiving formal resuscitation education early in their studies, to avoid contamination data collection was only possible during a limited time frame. Due to poor rates of participation a further two attempts were made to recruit novice nursing student to the

Learning and Evaluation (phase 2) component of this investigation, though again the limited time frame and smaller population resulted in few participants. As the next intake commenced in September 2014 it was possible to gain data from those who attended a pre-course day earlier in the month. This was allowed by the ethical approval, as those attending would gain better insights into course teaching in an area they would soon receive formal instruction on and all participants had to actively opt in to participate. The researcher's School based annual review of doctoral studies also suggested a further attempt at collecting data for the Learning and Evaluation component (phase 2) and though the sample achieved remained under powered, analysis of the data identified significant findings into the contribution RLOs can play in education.

6.4.4 Development of Learning Object by Researcher

The development of the student-designed and tutor-designed RLO by the researcher was for pragmatic reasons and it is accepted this could reduce the methodological objectivity. However, the investigation adopted strict protocols following an established theoretical structure and principles of learning object design and development reported by Windle & Wharrad (2010). Additionally the designer participants were contacted for comment on the development of their RLO (Appendix 8.10) so they could review their resource as it progressed therefore minimising any researcher bias in their final learning object.

The research project was undertaken over a three year period commencing with the Storyboard Workshops (phase 1), the development of the student-designed and tutor-designed learning object and then the Learning and Evaluation (phase 2). A more compressed time span could facilitate a more efficient design process though cost meant this option was not available and may conversely added delay, as another party would have been involved. To have developed the learning objects with no reference to the original designers would have been methodologically and ethically unsound, greatly detracting from the validity of the results.

6.5 Recommendations for future research

There are three areas where research investigating the design of RLOs could profitably move to; 1) RLOs for nursing students to learn other

clinical skills, 2) the involvement of other designers 3) a longer term investigation evaluating RLO use and the effect on individuals behaviour in practice (Kirkpatrick Level 3) and an organisations results (Kirkpatrick Level 4) and these will be discussed below.

6.5.1 Other Clinical Skill RLOs.

Building directly on this work a group of nursing students and separately tutors could be asked to design a learning object for novice nursing students to acquire other established clinical skills type knowledge, for example how to manually record a person's blood pressure. This work could confirm whether students and tutors do function differently when designing a learning object, whether learning objects significantly enhance knowledge acquisition irrespective of designer and if a student designed learning object confers significantly enhanced confidence in knowledge or further research is necessary to better understand the design process.

6.5.2 Student and User Designers of Learning Objects

Adopting the same methodology with different health professional disciplines (e.g. medical or allied health professional students) or with non-health professional disciplines (e.g. science, engineering, history) could provide evidence of the role students can play in the design of learning objects used to learn established knowledge. The involvement in a research project of qualified health practitioners such as Registered Nurses, employees' out with the University or voluntary support sector such as self-help groups may establish the value of including the user in the initial design of a learning object. Being asked to contribute to and shape an educational resource may attract students to become involved in a workshop designing a learning object their near peers can use to acquire established knowledge. A student involved in the initial design may gain benefit with their contribution providing a tangible acknowledgement of their effort as their peers will be using a student designed educational resource more aligned to their learning needs (Chang et al, 2008). It would also be useful to identify with interviews and focus groups what pedagogical factors designers believe enhance learning.

6.5.3 More Evidence of RLOs Learning Gains

The contribution learning objects can play in students learning established knowledge is apparent, though longer-term research measuring the effect these types of educational resource have on an individual's behaviour in practice (Kirkpatrick Level 3) and on an organisation's results (Kirkpatrick Level 4) could provide strong evidence supporting this method of knowledge acquisition. The design of more effective resources should enhance the learning achieved in a more effective and efficient manner, leaving space in the curriculum to apply the knowledge acquired and enhance student satisfaction, as they will retain more control over how and where they learn. A University can update a learning object as established knowledge evolves and though there will be an initial investment of time and resources these should be outweighed by the benefits of deploying effective learning objects demonstrating a university's commitment to providing evidence based education in the Information Age.

6.6 Reflexivity on the research process

This investigation adopted a mixed methods approach with the Storyboard Workshop (phase 1) complemented by the Learning and Evaluation (phase 2) of the investigation, with the development of the student-designed and tutor-designed learning objects between phase 1 and 2. In phase 1 the application of established theory (Tuckman's stages of group development model and the LOAM Tool categorising pedagogical factors discussed) allowed new insight into how students and separately how tutors function as a group and what pedagogical factors are discussed, during a storyboard creation workshop in the design of a reusable learning object used to learn established knowledge. To measure the effectiveness of the student-designed and tutor-designed resource, phase 2 of this research comprised novice nursing students randomised to view one of the learning objects with the participants unaware whether the designer of the resource view were students or tutors.

A social constructivist model of education may suggest students and tutors should have worked together in the storyboard design though this would have obscured any differences in how each group functioned and what they discussed. Just because a social constructivist approach to learning is

prevalent – see section 1.3.1, and is an approach I personally support - it does not necessarily follow educational resources **must** be designed by mixed groups of designers; it may be students are more attuned to their peers' learning needs by virtue of recently undertaking this learning. The modified grounded theory exploratory sequential with participatory design principles methodology allowed the voice of the student to be heard in the design and with the results showing this approach is worthy of further investigation. When designing learning objects for other students to use in acquiring established knowledge, learning object that allow students to achieve the most effective and efficient learning should be given more priority and this will only be possible when the design of a resource is understood and the learning quantified.

This research demonstrates students and tutors do function differently during a storyboard creation workshop and learning occurred irrespective of designer though the student-designed resources conferred significantly more confidence in knowledge acquisition. It is possible this is because student designers were more focussed on the task they had been asked to complete and not distracted by knowledge acquired by tutors from their professional careers.

The recruitment of participants for the storyboard creation workshops followed a planned process, though I cannot ignore the involvement of colleagues in the tutor group. However to minimise any potential bias the research followed structured plans with impartial reference to the students and tutor work. Adopting the Tuckman group development model and LOAM pedagogical factors tool with descriptors for each category demonstrates objectivity required of research and when analysing data, structured plans were followed to ensure consistency when viewing the storyboard workshop videos.

As an academic and Registered Nurse undertaking doctoral studies though at times difficult and challenging is a process I am immensely proud of and a significant milestone in my professional and personal development. This has included a number of conference presentations (Williams, Windle & Wharrad, 2012; Williams, Windle & Wharrad, 2014; Williams, Wharrad & Windle, 2015) and I plan to submit three substantive articles to nurse education and e-learning journals. One article will report how education

has and is likely to continue to change in the Fourth Industrial Revolution, a second to report my research findings and third article providing a practical guide for learning object designers to refer to. I hope this investigation will contribute to learning and education and has been achieved by working through these difficulties, perseverance and the support of my supervisors, colleagues and family, without which I would have been lost.

The design of effective learning objects in the Information Age is essential if students are to achieve the most they can from education and research in this area must continue. In addition, that research should be sufficiently robust to support a debate on the role learning objects can play in education; as academics and role models we owe this to the students of today and tomorrow.

7 References

Abbot, R. (2010) Delivering quality-evaluated healthcare information in the era of Web2.0: design implications for Intute: Health and Life Sciences. **Health Informatics Journal.** 16(1):pp.5-14.

Abella, B., Alvardo, J., Myklebust, H., Edelson, D., Barry, A., O'Hearn, N., Vanden Hoek, T. and Beck L. (2005a) Quality of cardiopulmonary resuscitation during in-hospital cardiac arrest. **Journal of the American Medical Association**. 293(3):pp.305-310.

Abella, B., Sandbo, N., Vassilitos, P., Alvardo, J., O'Hearn, N., Wigder, H., Hoffman, P., Tynus, K., Vanden Hoek, T., and Becker, L. (2005b) Chest compressions rates during cardiopulmonary resuscitation are suboptimal: A prospective study during in-hospital cardiac arrest. **Circulation.** 111(4):pp. 428-434.

Acierno, L. and Worrell, T. (2007) Peter Safar: father of modern cardiopulmonary resuscitation. **Clinical Cardiology**. 30(1):pp.52-54

Ackermann, A. (2009) Investigation of learning outcomes for the acquisition and retention of CPR knowledge and skills learned with the use of high-fidelity simulation. **Clinical Simulation in Nursing.** 5: e213-222.

Acosta, P., Varon, J., Sternbach, G., and Baskett, P. (2005) Kowenhoven, Jude and Knickerbocker The introduction of defibrillation and external chest compressions into modern resuscitation. **Resuscitation**. 64:pp.139-145.

Allen, K., Wong, N., Aves, T., and Dorian, P. (2012) The benefits of a simplified method for CPR training of medical professionals: A randomised controlled study. **Intensive Care Medicine.** 38(Suppl. 1):S301 1117.

American Heart Association (2015) **Highlights of the 2015 American Heart Association Guidelines Update for CPR and ECG** [online]. Available at: http://eccguidelines.heart.org/wp-content/uploads/2015/10/2015-AHA-Guidelines-Highlights-English.pdf [Accessed 29 November 2016].

American Psychological Association (2016) Teaching tip sheet: Self-efficacy [online]. Available at http://www.apa.org/pi/aids/resources/education/self-efficacy.aspx [Accessed 29 November 2016].

Anderson, T. and Wark, N. (2004) Why do teachers get to learn the most? [online]. **E-Journal of Instructional Science and Technology.** 7(2). Available at: http://auspace.athabascau.ca/bitstream/2149/734/1/why_do_teachers_get.pdf [Accessed 29 November 2016].

Andrew, N. and Ferguson, D. (2008) Constructing communities for learning in nursing. **International Journal of Nursing Education Scholarship.** 5(1): Article 24.

Anon (2016a) Where the smart is. **The Economist** [online]. Available at: https://www.economist.com/news/business/21700380-connected-homes-will-take-longer-materialise-expected-where-smart [Accessed 26 November 2017].

Anon (2016b) How to make a good teacher. **The Economist** [online]. Available at http://www.economist.com/news/leaders/21700383-what-matters-schools-teachers-fortunately-teaching-can-be-taught-how-make-good [Accessed 29 November 2016].

Anthony, D. (1999) **Understanding Advanced Statistics. A guide for Nurses and Health Care Researchers.** London. Churchill Livingstone.

Aparicio, M., Bacao, F. and Oliveria, T. (2016) An e-Learning theoretical framework. **Educational Technology and Society.** 19(1):pp.292-307

Attwell, G. (2006) **Evaluating e-learning. A guide to the evaluation of e-learning** [online]. Available at: http://pontydysgu.org/wp-content/uploads/2007/11/eva_europe_vol2_prefinal.pdf [Accessed 29 November 2016].

Badger, T. and Rawstorne, D. (1998) An evaluative study of pre-registration nursing students' skills in basic life support. **Nurse Education Today.** 18:pp.231-236.

Ballantine, J., McCourt-Larres, P. and Oyelere, P (2007) Computer usage and the validity of self-assessed computer competence among first-year business students. **Computers and Education.** [online]. 49:pp.976-990. Available at https://doi.org/10.1016/j.compedu.2005.12.001 [Accessed 11 February 2018].

Bandura, A. (1977) Self efficacy: towards a unifying theory of behavioural change. **Psychological Review.** 84:(2)pp.191-215

Bandura, A. (1982) Self-efficacy mechanism in human agency. **American Psychologist.** 37(2):pp.122-147.

Barr, J. and Dowding, L. (2012) **Leadership in Health Care Second edition.** SAGE Publications. London.

Batalden, M., Batalden, P., Margolis, P., Seid, S., Armstrong, G., Opipari-Arringan, L. and Hartung, H. (2016) Coproduction of healthcare service. **BMJ Quality and Safety** [online]. 25(7):pp.509-517. Available at: 10.1136/bmjqs-2015-004315 [Accessed 29 November 2016].

Beadle, M., Needham, Y. and Dearing, M. (2012) Collaboration with service users to develop reusable learning objects: The ROOT to success. **Nurse Education in Practice.** 12:pp.352-355.

Becher, T. and Trowell, P. (2001) **Academic tribes and territories. Second edition.** Buckingham. Open University Press.

Beetham, H. and Sharpe, R. (Eds.) (2013) **Rethinking Pedagogy for a Digital Age.** Abingdon. Routledge.

Biggs, J. (1999) What the student does: teaching for enhanced learning. **Higher Education Research and Development.** 18(1)pp. 57-75.

Biggs, J. and Tang, C. (2011) **Teaching for Quality Learning at University.** Maidenhead. Open University Press.

Birks, M., Chapman, Y. and Francis, K. (2006) Moving grounded theory into the 21st century: Part 2 – mapping the footprints. **Singapore Nursing Journal.** 33(4):pp.12-17

Blake, H. (2010) Computer-based learning objects in healthcare: the student experience. **International Journal of Nursing Education Scholarship.** 7(1). Art 16 pp. 1-15

Bond, C. (2004) Surfing or drowning? Student nurses' Internet skills. **Nurse Education Today.** 24:pp.169-173

Bond, C. (2010) Surfing or still drowning? Student nurses' Internet skills. **Nurse Education Today.** 30:pp.485-488

Bonebright, D. (2010) 40 years of storming: a historical review of Tuckman's model of small group development. **Human Resource Development International.** 13(1):pp.111-120.

Bovill, C., Cook-Sather, A. and Felten, A. (2011) Students as co-creators of teaching approaches, course design, and curricula: implications for academic developers. **International Journal for Academic Development.** 16(2):pp133-145.

Bowden, T., Rowlands, A., Buckwell, M. and Abbott, S. (2012) Web-based video and feedback in the teaching of cardiopulmonary resuscitation. **Nurse Education Today.** 32:pp.443-447.

Duchscher, J., and Morgan, D. (2004) Grounded theory: reflections on the emergence vs. forcing debate. **Journal of Advanced Nursing** 48(6):pp.605-612

Boyle, T. (2003) Design principles for authoring dynamic, reusable learning objects. **Australian Journal of Educational Technology.** 19(1):pp.46-68.

Boyle, T., Cook, J., Windle, R., Wharrad, H., Leeder, D. and Alton, D. (2006) An Agile method for developing learning objects. **Proceedings of the 23rd annual ascilite conference**: Who's learning? Whose technology? [online]. Available at: http://www.ascilite.org/conferences/sydney06/proceeding/pdf_papers/vol2.pdf [Accessed 29 November 2016].

Bremer, C. (2012) Enhancing e-learning quality through the application of the AKUE procedure model. **Journal of Computer Assisted Learning.** 28(1):pp.15-26

Brooman, S., Darwent, S and Pimor, A. (2015) The student voice in higher education curriculum design: is there value in listening? **Innovations in Education and Teaching International.** 52(6):pp. 663-674.

Brown, M. (2015) Six trajectories for digital technology in higher education. **EDUCAUSE Review.** 43(1):pp16-28.

Browne (2010) **Independent Review of Higher Education Funding & Student Finance.** [online]. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/422565/bis-10-1208-securing-sustainable-higher-education-browne-report.pdf [Accessed 29 November 2016].

Bruce, S., Scherer, Y., Curran, C., Urschell, D., Erdley, S., and Ball, L. (2009) A collaborative exercise between graduate and undergraduate nursing students using a computer-assisted simulator in a mock cardiac arrest. **Nursing Education Perspectives** 30(1):pp.22-27.

Buchanan D. and Bryman A. (2009) **The SAGE Handbook of Organisational Research Methods.** London. SAGE Publications Ltd.

Buck-Barrett, I. and Squires, I. (2004) The use of basic life support skills by hospital staff; what skills should be taught? **Resuscitation.** 60:pp. 39-44.

Bulfin, S., Henderson, M. and Johnson, N. (2013) Examining the use of theory within educational technology and media research. **Learning, Media and Technology.** 38(3)pp.37-344, DOI: 10.1080/17439884.2013.790315

Bush, V. (1945) As we may think. The Atlantic Monthly. July 1945 [online]. Available at: https://www.theatlantic.com/magazine/archive/1945/07/as-we-may-think/303881/ [Accessed 11 February 2018].

Butson, R. (2003) Learning objects: weapons of mass instruction. **British Journal of Educational Technology.** 34(5):pp667-669.

Cable, V. (2012) **Supporting social mobility and lifelong learning** [online]. Available at: https://www.gov.uk/government/speeches/supporting-social-mobility-and-lifelong-learning [Accessed 29 November 2016].

California State University (2016) **Exemplary Online Instruction** [online]. Available at: http://www.csuchico.edu/eoi/ [Accessed 29 November 2016].

Calkin, S. (2013) Mid staffs nurses who failed to act over death stay on register **Nursing Times** 109(25):pp.5

Campbell, F. Eland, J., Rumpus, A. and Shacklock, R. (2009) **Hearing the student voice. Involving students in curriculum design and delivery. Final Report** [online]. Available at: http://www.sparqs.ac.uk/ch/E3%20Hearing%20the%20student%20voice%20involving%20students%20in%20curriculum%20design%20and%20development.pdf [Accessed 29 November 2016].

Campbell, M. and Swinscow, T. (2009) **Statistics at Square One - 11th edition.** Chichester. John Wiley and Sons Ltd.

Cason, C. and Baxley, S. (2011) Learning CPR with the BLS Anytime™ for healthcare providers kit. **Clinical Simulation in Nursing.** 7:e237-e243.

Castle, N., Garton, H. and Kenward, G. (2007) Confidence vs competence: basic life support skills of health professionals. **British Journal of Nursing.** 16(11):pp.664-666.

Chang, R., Kennedy, G. and Petrovic, T. (2008) Web2.0 and user-created content: Students negotiating shifts in academic authority. In *Hello! Where are you in the landscape of educational technology?* ***Proceedings ascilite Melbourne 2008.*** [online]. Available at: http://www.ascilite.org/conferences/melbourne08/procs/chang.pdf [Accessed 29 November 2016].

Charmaz, K. (1990) Discovering chronic illness: using grounded theory. **Social Science & Medicine.** 30(11):pp.1161-1172

Chesser-Smyth, P. and Long, T. (2102) Understanding the influences on self-confidence among first-year undergraduate nursing students in Ireland. **Journal of Advanced Nursing.** 69(1)145-157.

Chung, S. and Fitzsimmons, V. (2013) Knowing Generation Y: a new generation of nurses in practice. **British Journal of Nursing.** 22(20):1173-1179.

Church, J., Martz, D. and Cook, N. (2006) The use of digital video recorders (DVRs) for capturing digital video files for use in both The Observer and Ethovision. **Behavioural Research Methodology.** 38(3):pp.434-438.

Clapper, T. (2010) Beyond Knowles: What those conducting simulation need to know about adult learning theory. **Clinical Simulation in Nursing.** 6:e7-e14.

Cohen, L. Manion, L. and Morrison, K. (2005) **Research methods in education. 5th edition.** Abingdon. Routledge Falmer.

Cole, M. and John-Steiner, V. (1980) **Vygotsky, L.S. Mind in Society: The Development of Higher Psychological Processes. Cambridge**. MA. Harvard University Press.

Connolly, P. (2007) **Quantitative Data Analysis in Education**. Abingdon. Routledge.

Conole, G. (2008). Listening to the learner voice: The ever changing landscape of technology of technology use for language students. **ReCALL.** 20(2):pp124-140.

Conole, G. (2013) **Designing for Learning in an Open World**. New York. Springer.

Conole, G. (2014) The 7Cs of Learning Design – a new approach to rethinking design practice. ***Proceedings of the 9th International Conference on Networked Learning*** 18 March 2014. Edinburgh, Scotland.

Conole, G., de Laat, M., Dillon, T. and Darby, J. (2008) Disruptive technologies', 'pedagogical innovation': What's new? Finding from an in-depth study of students' use and perception of technology. **Computers and Education.** 50(?):pp511-524

Conole, G., Dyke, M. Oliver, M. and Seale, J. (2004) Mapping pedagogy and tools for effective learning design. **Computers and Education.** 43:(1-2)pp.17-33

Cook, J. (2010a) Longitudinal, educational design research investigation of the temporal nature of learning: taking a Vygotskian approach. **Journal of Interactive Media in Education** Available at: http://jime.open.ac.uk/articles/10.5334/2010-11/print/ [Accessed 5 June 2017].

Cook, J. (2010b) Mobile phones as mediating tools within Augmented Contexts for Development. **International Journal of Mobile and Blended Learning.** 2(3):pp1-12

Cook, J., Mor, Y. Santos, P. Treasure-Jones, T. Elferink, R. and Kerr, M. (2016) Using participatory patterns design (PPD) methodology to co-design groupware: Confer a tool for workplace informal learning. **EdMedia 2016, Vancouver, BC, Canada26-30 June 2016**

Cook, N., McAloon, T., O'Neill, P. and Beggs, R. (2012) Impact of a web based interactive simulation game (PULSE) on nursing students' experience and performance in life support training – a pilot study. **Nurse Education Today.** 32:pp.714-720.

Corbally, M. (2005) Considering video production? Lessons learned from the production of a blood pressure measurement video [Online]. **Nurse Education in Practice.** 5(6):pp.375-379.

Coulter, A., Roberts, S. and Dixon, A. (2015) Delivering better services for people with long-term conditions. Building the house of care [online]. **The King's Fund.** Available at: https://www.kingsfund.org.uk/sites/files/kf/field/field_publication_file/delivering-better-services-for-people-with-long-term-conditions.pdf [Accessed 29 November 2016].

Creative Commons. (undated) **Education** [online]. Available at: https://creativecommons.org/ [Accessed 29 November 2016].

Creswell J and Plano Clark V. (2007) **Designing and conducting mixed methods research.** London SAGE Publications.

Cummins, R., Ornato, J., Thies, W. and Pepe, P. (1991) Improving survival from sudden cardiac arrest: the "chain of survival" concept. A statement for health professionals from the Advanced Cardiac Life Support Subcommittee and the Emergency Cardiac Care Committee, American Heart Association. **Circulation.** 83:pp.1832-1847.

Currens, J. (2011) How Might the Student Voice Affect Transformation in Higher Education? In **The Student Voice Handbook: Bridging the Academic/Practitioner Divide.** Eds. Czerniawski, G and Kidd, W. Bingley, Emerald Group Publishing Limited.

Currier, S. and Campbell, L. (2005) Evaluating 5/99 content for reusability as learning objects. **VINE Journal of Information and Knowledge Management Systems.** 35(1/2):pp1522-1532

Curry, L. and Gass, D. (1987) Effects of training in cardiopulmonary resuscitation on competence and patient outcome. **Canadian Medical Association Journal.** 137:pp.491-496.

Cutliffe, John R. (2005) Adapt or adopt: developing and transgressing the methodological boundaries of grounded theory. Journal of Advanced Nursing 51(4):pp.421-428

Dalziel, J., Conole, G. Wills, S., Walker, S., Bennett, S., Dobozy, E., Cameron, L., Badilescu-Buga, E and Bower, M. (2016) The Larnaca Declaration on Learning Design. **Journal of Interactive Media in Education.** 1(7):pp1-24.

Daniel, J. (2012) Making sense of MOOCs: musing in a maze of myth, paradox and possibility [online]. **Journal of Interactive Media** Available at: https://jime.open.ac.uk/articles/10.5334/2012-18/ [Accessed 26 January 2018].

Davies, N. and Gould, D. (2000) Updating cardiopulmonary resuscitation skills: a study to examine the efficacy of self-instruction on nurses' competence. **Journal of Clinical Nursing.** 9:pp.400-410.

Dean, M., Guo, Y. Jun, W., Kaschek, R., Krishnaswamy, S., Pan, Z. and Sheng, Q (2005) **Web Information Systems Engineering WISE 2005 Workshops** [online]. Available at: https://books.google.co.uk/books?id=YC4l5bcEJtEC&pg=PA107&lpg=PA107&dq=valkenburg-group.org&source=bl&ots=7wUDT3NfUE&sig=uoE8YwTPRLY_7ivM4mIOZeoChKA&hl=en&sa=X&ved=0ahUKEwibirO2-5rNAhXE2xoKHUoHAa4Q6AEIJjAC#v=onepage&q=valkenburg-group.org&f=false [Accessed 29 November 2016].

Dennick, R. (2015) Theories of learning: constructive experience. In Matheson, D. (Ed.) **An Introduction to the Study of Education.** Oxon. Routledge.

Denscombe, M. (2007) **The good research guide for small scale research projects.** Third edition. Maidenhead. Open University Press

Department of Business, Innovation and Skills (2011) **Higher Education: Students at the heart of the system.** Cm 8122. London. HMSO.

Department of Business, Innovation and Skills (2015) **Teaching at the heart of the system** [online]. Available at: https://www.gov.uk/government/speeches/teaching-at-the-heart-of-the-system [Accessed 29 November 2016].

Devlin, M. (1999) An evaluative study of the basic life support skills of nurses in an independent hospital. **Journal of Clinical Nursing.** 8:pp.201-205.

Dine, C., Geresh, R., Leary, M., Riegel, B. Bellini, L. and Abella, B. (2008) Improving cardiopulmonary resuscitation quality and resuscitation training by combining audio-visual feedback and debriefing. **Critical Care Medicine.** 36:(10)pp.2817-2822.

Dix, A. (2012) Networked-based interaction. In Jacko, J. (Ed) **The Human-Computer Interaction handbook. Fundamentals, evolving technologies and emerging applications. Third edition.** Boca Raton. CRC Press, Taylor Francis Group.

Dix, A., Finlay, J., Abowd, G. and Beale, R. (2004) Socio-organisational issues and stakeholder requirements. **Human-Computer Interaction Third Edition.** Harlow. Pearson Education Limited.

Dolan, E. Hancock, E. and Wareing, A. (2015) An evaluation of online learning to teach practical competencies in undergraduate health science students. **Internet and Higher Education.** 24:pp.21-25.

Ducharme, D. and Arcand, I. (2009) Using Noldus Observer XT for research on deaf signers learning to read: an innovative methodology. **Behavioural Research Methodology.** 41(3):pp.833-840

Duncan, I., Yarwood-Ross, L. and Haigh, C. (2013) YouTube as a source of clinical skills education. **Nurse Education Today** 33(12):pp.1576-1580

Edelbring, S. (2010) A threefold framework for relating to innovations and technology in education. In Bromage, A., Clouder, L., Thistlethwaite, J and Gordon, F. **Interprofessional E-Learning and Collaborative Work, Practices and Technologies**. Hershey PA, IGI Global.

Ellaway, R., Dalziel, J. and Dalziel, B. (2008) Learning design in healthcare education. **Medical Teacher**. 30(2):pp180-184

Ertmer, P. and Newby, R. (1993) Behaviourism, cognitivism, constructivism: comparing critical features from an instructional design perspective. **Performance Improvement Quarterly.** 6(4):pp50-72

Ertmer, P. and Newby, R. (2013) Behaviourism, cognitivism, constructivism: comparing critical features from an instructional design perspective. **Performance Improvement Quarterly.** 26(2):pp43-71

Fenton, G. (2014) Involving a young person in the development of a digital resource in nurse education. **Nurse Education in Practice.** 14:pp.49-54.

Ferguson, M., Brandreth, M., Brassington, W., Leighton, P., and Wharrad, H. (2015) A randomized controlled trial to evaluate the benefits of a multimedia educational program for first-time hearing aid users. **Ear and Hearing.** 37(2):pp.123-136

Finn, J. (2010) E-learning in resuscitation training – students say they like it, but is there evidence that it works? **Resuscitation.** 81:pp.790-791.

Flamm, K. (2017) Has Moore's Law been repealed? An economist's perspective. **Computing in Science and Engineering.** 19(2):pp.29-40

Friesen, N. (2003) Three objections to learning objects and e-learning standards [online]. Available at: http://www.learningspaces.org/papers/objections.html [Accessed 25 Jan 2018].

Friesen, N., Gourlay, L. and Oliver, M. (2014) Editorial: scholarship and literacies in a digital age. **Research in Learning Technology.** [online] 21, 23834. doi: 10.3402/rlt.v21.23834 [Accessed 25 Jan 2018].

Fry, H., Ketteridge, S. and Marshall S. (2009) **A handbook for teaching and learning in higher education enhancing academic practice.** Third edition. Abingdon: Routledge.

Frydenberg, M. (2013) Peer tutoring in the CIS sandbox: does it work [online]. **Proceedings of International Association for Development of the Information Society (IADIS) International Conference on e-Learning, 23-26 Jul 2013 Prague, Czech Republic** http://eric.ed.gov/?id=ED562321 [Accessed 29 November 2016].

Furmedge, D., Iwata, K and Gill, D. (2014) Peer-assisted learning – Beyond teaching: How can medical students contribute to the undergraduate curriculum? **Medical Teacher.** 36:pp.812-817.

Galway, L., Corbett, K., Takaro, T., Taiyran, K and Frank, E. (2014) A novel integration of online and flipped classroom instructional models in public health higher education [online]. **BMC Medical Education.** 14:p.181 Available at: http://bmcmededuc.biomedcentral.com/articles/10.1186/1472-6920-14-181 [Accessed 29 November 2016].

Garfield, M. and Denis, A. (2012) Towards an integrated model of group development: Disruption of routines by technology-induced change. **Journal of Management Information Systems.** 29(3):pp.43-86

Garrison, R. (2017) **E-Learning in the 21st Century.** Oxon. Taylor & Francis.

Gartner (2017) **Gartner Hype Cycle**. [Online]. Available at: https://www.gartner.com/technology/research/methodologies/hype-cycle.jsp Accessed: 17 December 2017.

Gehringer, E., Ehresman, L., Conger, S. and Wagle, P. (2007) Reusable Learning Objects Through Peer Review: The Expertiza Approach [online]. **Innovate: Journal of Online Education** 3(5) Article 4. Available at: http://nsuworks.nova.edu/innovate/vol3/iss5/4 [Accessed 11 February 2018].

Gersick, C. (1988) Time and transition in new work teams: towards a new model of group development. **Academy of Management Journal.** 31(1):pp.9-41

Goldie, J. (2016) Connectivism: A knowledge learning theory for the digital age? **Medical Teacher.** 38(10):pp1064-1069.

Goodyear, P. (2015) Teaching as design. **Higher Education Research and Development Society of Australasia.** 2:pp27-50 [online]. Available at http://www.herdsa.org.au/herdsa-review-higher-education-vol-2/27-50 [Accessed 23 Nov 2017].

Gordon, F., Booth, K. and Bywater, H (2010) In Bromage, A.,Clouder, L., Thistlethwaite, J and Gordon, F. **Interprofessional E-Learning and Collaborative Work, Practices and Technologies**. Hershey PA, IGI Global.

Gordon, S. (2010) Once you get them, how do you keep them? Millennial librarians at work. **New Library World**. 111(9/10): pp391-398 https://doi.org/10.1108/03074801011089314

Gray, D. (2014) **Doing research in the real world. 3rd edition.** London SAGE Publications Ltd.

Green, H. and Hanlon, C. (2007) Young people are spending their time in a space which adults find difficult to supervise or understand… [online]. Available at: http://dera.ioe.ac.uk/23215/1/Their%20space%20-%20web.pdf London DEMOS [Accessed 24 January 2018].

Greig, M., Elliott, D., Parboteeah, S. and Wilks, L. (1996) Basic life support skills acquisition and retention in student nurses undertaking a pre-registration diploma in higher education/nursing course. **Nurse Education Today.** 16:pp.28-31.

Guler, C. Altun, A. and Askar, P. (2009) Developing reusable learning objects: Hacettepe University Case. **Paper presented at the Proceedings of Third International Conference on Internet Technologies and Applications (ITA 09) Conference, 8-11 September 2009, Wrexham, UK.**

Guler, C. and Altun, A. (2010) Teacher trainees as learning object designers: problems and issues in learning object development process. **The Turkish Online Journal of Educational Technology.** [online]. 9(4):pp.118-127. Available at: http://www.tojet.net/articles/v9i4/9412.pdf [Accessed 29 November 2016].

Hale, L., Mirakian, E. and Day. D. (2009) Online vs. classroom instruction: student satisfaction and learning outcomes in an undergraduate allied health pharmacology course. **Journal of Allied Health.** 38:(2)e36-42

Hall, T. (2015) Does cohesion positively correlate to performance in all stages of a group's life cycle? Journal of Organisational Culture, Communications and Conflict 19(1):pp.58-71

Handley, J. and Handley, A. (1998) Four-step CPR – improving skill retention. **Resuscitation.** 36:pp.3-8.

Harasim, L. (2017) **Learning theory and online technologies Second edition.** Abingdon Routledge.

Harden, R. (2005) A new vision for distance learning and continuing medical education. **The Journal of Continuing Education in the Health Professions.** 25:pp.43-51.

Haythornthwaite, C. and Andrews, R. (2011) **E-learning Theory and Practice.** London. SAGE Publications Ltd.

Haythornthwaite, C., Andrews, R., Fransman, J. and Meyers, (2016) **The SAGE Handbook of E-learning Research**. London. SAGE Publications Ltd.

Health E-Learning and Media Team (undated) RLO Templates: Production Plan [online]. Available at: http://www.nottingham.ac.uk/nmp/sonet/rlos/templates/plan.php [Accessed 29 November 2016].

HEFCE (2010) **Student perspectives on technology – demand, perceptions and training needs** [online]. Available at: http://www.hefce.ac.uk/media/hefce/content/pubs/2010/rd1810/rd18_10.pdf [Accessed 29 November 2016].

HEFCE (2015) **National Students Survey** [online]. Available at: http://www.hefce.ac.uk/lt/nss/ [Accessed 29 November 2016].

Henle, R. and Hill, L. (1966) Integrated computer circuits - past, present and future. **Proceeding of the IEEE.** 54(12):pp1849-1860.

Higher Education Statistics Authority (undated) **Free Online Statistics – Students & qualifiers** [online]. Available at: https://www.hesa.ac.uk/stats [Accessed 29 November 2016].

Himelfield, D. (2014) Care home nurse refused to do CPR and called NHS Direct as patient lay dying, inquest hears. **The Huddersfield Daily Examiner** 20 February 2014 [online]. Available at http://www.examiner.co.uk/news/west-yorkshire-news/care-home-nurse-refused-cpr-6727866 [Accessed 29 November 2016].

Hinckley, K. and Wigdor, D. (2012) Input technologies and techniques. In Jacko, J. **The Human-Computer Interaction handbook-. Fundamentals, evolving technologies and emerging applications. Third edition.** Boca Raton. CRC Press, Taylor Francis Group.

Hinkin, T. (1995) A review of scale development practices in the study of organisations. **Journal of Management**. 21(5):pp.967-988.

Holloway, I. and Galvin K. (2015) Grounded Theory. In Gerrish, K. and Lathlean, J. (Eds.) **The Research Process in Nursing** Seventh edition. Chichester. WILEY Blackwell.

Holmes, (2011) Cyberkids or divided generations? Characterising young people's internet use in the UK with generic continuum or typological models. **New Media and Society.** 13(7):pp1104-1122.

Holzhauser, K., Winch, S. and Henderson, A. (2008) Response to editorial: Watson, R. (2006) Editorial: Should studies without ethical permission be published in *JCN? Journal of Clinical Nursing 15, 251* **Journal of Clinical Nursing.** 17(6):p837.

Honey, M. and Proctor, P. (2017). The shifting sands of nursing informatics education: from content to connectivity. In: Murphy, J., Goossen, W. and Weber, P. (eds.) Forecasting informatics competencies for nurses in the future of connected health: **Proceedings of the Nursing Informatics Post Conference 2016.** Studies in Health Technology and Informatics (232). Online, IOS Press, 31-40

Hooper, B., Greene, D. and Sample, P. (2014) Exploring features of integrative teaching through a microanalysis of connection-making processes in a health sciences curriculum. **Advanced in Health Science Education** 19(4):pp.469-495

Hopkins, L., Hampton, B., Abbott, J., Buery-Joyner, S., Craig, L., Dalrymple, J. Forstein, D. Graziano, S., McKenzie, M., Pradham, A. Wolf, A. and Page-Ramsey, S. (2018) To the point: medical education, technology, and the millennial learner. **American Journal of Obstetrics and Gynecology.** 218(2):pp188-192

Hurst, K. (2016) Using video podcasting to enhance the learning of clinical skills: A qualitative study of physiotherapy students' experiences. **Nurse Education Today** [online]. 45:pp.206-211 Available at DOI: 10.1016/j.nedt.2016.08.011 [Accessed 11 February 2018].

Hurt, A. and Trombley, S. The Punctuated –Tuckman: towards a new group development model. **International Research Conference in The Americas of the Academy of Human Resource Development (Indianapolis, IN, Feb 28-Mar 4, 2007)**

Hutchings, S., Hall, J. and Lovelady, B. (2004) **Teamwork. A guide to collaboration in health and social care.** Bicester, Oxon. Speechmark Publishing Ltd.

Hutchinson, D., Brown, J. and Longworth, K. (2012) Attracting and maintaining the Y Generation in nursing: a literature review. **Journal of Nursing Management.** 20:pp.444-450.

ILCOR (2017) **About ILCOR** [online]. Available at: http://www.ilcor.org/about-ilcor/about-ilcor/ [Accessed 6 June 2017].

IMS Global Learning Consortium (2003) **IMS Learning Design Information Model** [online]. Available at: https://www.imsglobal.org/learningdesign/ldv1p0/imsld_infov1p0.html [Accessed 29 November 2016].

Institute Of Educational Technology (2017) **Innovating Pedagogy Reports.** [Online]. Available at: https://iet.open.ac.uk/innovating-pedagogy Accessed 19 December 2017.

Jacko, J. (2012) **The Human-Computer Interaction handbook. Fundamentals, evolving technologies and emerging applications. Third edition.** Boca Raton. CRC Press, Taylor Francis Group.

Jahng, N. (2012) An investigation of collaboration processes in an online course: How do small groups develop over time? **The International Review of Research in Open and Distributed Learning**, 13(4):pp1-18. Available at: <http://www.irrodl.org/index.php/irrodl/article/view/1211/2281 [Accessed 11 Feb. 2018]. doi:http://dx.doi.org/10.19173/irrodl.v13i4.1211.

Jesse, E., Taleff, J., Payne, P., Cox, R. and Steele, L. (2006) Reusable learning units: an innovative teaching strategy for online nursing education. **International Journal of Nursing Education Scholarship.** 3(1): Article 28.

Jiang, D. (2014) What will Web 3.0 bring to education? **World Journal on Educational Technology.** 6(2):pp126-131.

JISC (2005) ACETS: **Assemble, Catalogue, Exemplify, Test and Share Special Reports 8** [online]. Available at: http://www.archive.mvm.ed.ac.uk/acets/acetspub.pdf [Accessed 29 November 2016].

Jochems, W., van Merriëboer, J. and Koper, R. (2004) **Integrated e-learning. Implications for pedagogy, technology and organisation**. London, RoutledgeFalmer.

Johnson, S., Suriya, C., Yoon, S. Berrett, J. and La Fleur, J (2002) Team development and group processes of virtual learning teams. **Computers and Education.** 39(4):pp.379-393

Josipovic, P., Webb, M. and McGrath, I. (2009) Basic life support knowledge of undergraduate nursing and chiropractic students. **Australian Journal of Advanced Nursing.** 26(4):pp.58-63.

Kalman (2014) A race to the bottom: MOOCs and higher education business models. **Open learning: The Journal of Open, Distance and e-Learning.** 29:(1)pp.5-14.

Kay, R. and Knaack, L (2008) A multi-component model for assessing learning objects: The learning object evaluation metric (LOEM). **Australian Journal of Educational Technology.** Vol 24(5):pp574-591.

Kaye, W., Rallis, S., Mancini, M., Linhares, K., Angell, M., Donovan, D., Zajano, N. and Finger, J. (1991) The problem of poor retention of cardiopulmonary resuscitation skills may lie with the instructor, not the learner or the curriculum. **Resuscitation.** 21:pp.67-87.

Keating, E., O'Donnell, E. and Starr, S. (2013) How we created a peer-designed specialty-specific selective for medical students career exploration. **Medical Teacher.** 35:pp.91-94.

Keefe, G. and Wharrad, H. (2012) Using e-learning to enhance nursing students' pain management education. **Nurse Education Today**. 32(8), e66-72 Doi: 10.1016/j.nedt.2012.03.018

Kennedy, G., Judd, T., Dalgarnot, B. and Waycott, T. (2010) Beyond natives and immigrants: exploring types of net generation students. **Journal of Computer Assisted Learning.** 26(5):pp.332-343

Kennedy, G., Krause, K., Gray, K., Judd, T. and Bennett, J. (2006). Questioning the net generation: a collaborative project in Australian higher education. **Proceeding of the 23rd annual ascilite conference: Who's learning? Whoes technology.** Available at**:** http://ro.uow.edu.au/edupapers/614

Ker, J. and Hesketh, A. (2003) Creating teaching materials. In Cantillon, P. and Wood, D. (Eds.) **ABC of Learning and Teaching in Medicine**. Oxford. BMJ Books.

Kerawalla, L., Littleton, K. Scanlon, E., Jones, A., Gaved, M., Collins, T., Mulholland, P., Blake, C., Clough, G., Conole, G. and Petrou, M. (2013) Personal inquiry learning trajectories in geography: technological support across contexts. **Interactive Learning Environments.** 21(6):pp497-515.

Kinchin, I., Cabot, L., Kobus, M. and Woolford, M. (2011) Threshold concepts in dental education. **European Journal of Dental Education.** 15(4):pp210-215

Kirkpatrick, D. (1996) Great ideas revisited. **Training and Development.** 50(1):pp.54-59.

Kirkpatrick, J. and Kirkpatrick, W. (2009) **The Kirkpatrick Four Levels™. A fresh look after 50 years 1959-2009** [online]. Available at: http://www.kirkpatrickpartners.com/Portals/0/Resources/Kirkpatrick%20Four%20Levels%20white%20paper.pdf [Accessed 29 November 2016].

Kneebone, R. and Nestel, D. (2011) **In Medical Education Theory and Practice.** Dornan, T., Mann, K., Scherpbier, A. and Spencer, J. Edinburgh. Churchill, Livingstone, Elselvier.

Kneebone, R. and Nestel, D. (2015) Learning and teaching clinical procedures. In Cleland, J. and Durning, S. Chichester. **Researching Medical Education.** Association for the Study of Medical Education. Chichester. Wiley Blackwell.

Koper, R. and Tattersall, C. (2005) **Preface to learning Design: A Handbook on Modelling and Delivering Networked Education and Training**. Berlin. Springer

Kurilovas, E. and Dagiene, V. (2010) Multiple Criteria Evaluation of Quality and Optimisation of e-Learning System Components. **The Electronic Journal of e-Learning.** 8(2):pp.141-151.

Kurilovas, E. and Serikoviene, S. (2013) New MCEQLS TFN method for evaluating quality and reusability of learning objects. **Technological and Economic Development of Society.** 19(4):p706-723.

Kurilovas, E. Bireniene, V. and Serikoviene, S. (2011) Methodology for evaluating quality and reusability of learning objects. **The Electronic Journal of e-Learning.** 9(1):pp.39-51.

Kurilovas, E., Serikoviene, S. and Vuorikari, R. (2014) Expert centred vs learner centred approach for evaluating quality and reusability of learning objects. **Computer in Human Behaviour.** [online]. 30:pp.526-534. Available at http://dx.doi.org/10.1016/j.chb.2013.06.047 [Accessed 29 November 2016].

Lafferty, N. (2013) **INIMEDS: An idea ahead of its time?** IAMSE Webinar 14 March 2013. Available at: http://www.iamse.org/seminar-archives/2013/published_was/was_031413/was_031413.html [Accessed 29 November 2016].

Landis, R. and Koch, G. (1977) The measurement of observer agreement for categorical data. **Biometrics.** 33(1):pp.159-174.

Largent, D. and Luer, C. (2010) "You mean we have to work together!?!" A study of the formation and interaction of programming teams in a college course setting [online]. **Ball State University.** Available at: http://cardinalscholar.bsu.edu/handle/123456789/193667 [Accessed 11 February 2018].

Laurillard, D. (2008) **Rethinking university teaching. A framework for the effective use of learning technologies. Second edition.** Abingdon. RoutledgeFarmer.

Laurillard, D. (2012) **Teaching as a design science. Building pedagogical patterns for learning and technology.** Abingdon. RoutledgeFarmer.

Leaver, R. (2012) Blending with the digital natives. **International Journal of Urological Nursing.** 6(3):pp.97-99.

Leeder D. (2009) Interactive e-learning development workshops. **Proceedings of the International Association for Development of the Information Society (IADIS) International Conference, 17-20 June 2009, Algarve, Portugal.** http://www.iadisportal.org/e-learning-2009-proceedings

Leigh, G. (2008) High-fidelity patients' simulation and nursing students' self –efficacy: a review of the literature. **International Journal of Nursing Education Scholarship.** 5(1)37 1-17

Leighton, K. and Scholl, K. (2009) Simulated codes: understanding the response of undergraduate nursing students. **Clinical Simulation in Nursing.** 5:e187-e194.

Levett-Jones, T., Kenny, R., Van der Riet, P., Hazelton, M., Kable, A., Bourgeois, S. and Luxford, Y. (2009) Exploring the information and communication technology competence and confidence of nursing students and their perception of its relevance to clinical practice. **Nurse Education Today.** 29(6):pp.612-616.

Lippencott, J. (2012) Information commons: Meeting millennials' needs. **Journal of Library Administration.** 52:6-7pp.538-548

Littlefield, M., Rubinstein, K. and Pittman, M. (2015) Beyond Powerpoint™: using learning objects to enhance social work courses. **Journal of Technology in Human Services.** 33:(2)pp.172-190

Littlejohn, A. and Peglar, C. (2007) **Preparing for blended-learning.** Abingdon. Routledge.

LOAM (2014) **Welcome to the LOAM tool** [online]. Accessible at http://www.nottingham.ac.uk/nmp/sonet/projects/loam/tool/index.html [Accessed 29 November 2016].

Lockspeisers, T., O'Sullivan, P., Teherani, A. and Muller, J. (2008) Understanding the experience of being taught by peers: the value of social and cognitive congruence. **Advanced in Health Science Education.** 13(3):pp.361-372.

Lockyer, L., Agostinho, S., and Bennett, S. (2016) Design for E-Learning In **The SAGE Handbook of E-learning Research (Second Edition).** London, SAGE Publications Ltd.

Luft, J. (1982) The Johari Window. A graphic model of awareness in interpersonal relations [online]. **NTL Reading Book for Human Relations Training.** pp34-35 Available at: http://c.ymcdn.com/sites/fridayfellowship.site-ym.com/resource/collection/D1FD72B3-693E-4EE5-AB18-B1233BBE9C51/JohariWindow_JLuft.pdf [Accessed 11 February 2018].

MacKenzie, S. (2013) **Human-computer interaction. An empirical research perspective.** London. Elselvier.

Mackway-Jones, K and Walker, M. (Eds.) (1999) Pocket guide for teaching medical instructors. London. BMJ Books.

Madden, C. (2006) Undergraduate nursing students' acquisition and retention of CPR knowledge and skills. **Nurse Education Today.** 26(3):pp.218-227.

Mann, K. and MacLeod, A. (2015) Constructivism: learning theories and approaches to research. **In Researching Medical Education.** Cleland, J. and Durning, S. Chichester. Association for the Study of medical Education.

Mann, K., Dornan, T. and Teunissen, P. (2011) Perspectives in learning. **In Medical Education Theory and Practice.** Dornan, T., Mann, K., Scherpbier, A. and Spencer, J. Edinburgh. Churchill, Livingstone, Elselvier.

Maran, N. and Glavin, R. (2003) Low- to high-fidelity simulation – a continuum of medical education? **Medical Education.** 37 (Suppl. 1):pp.22-28.

Marsden, A. (1989) Basic life support. **British Medical Journal.** 6696(299):pp.442-445.

Martin, P. and Bateson, P. (2007) **Measuring behaviour. An introductory guide. Second edition.** Cambridge. Cambridge University Press.

Matheson, C. and Matheson, D. (2015) Lifelong learning. In Matheson, D. (Ed.) **An Introduction to the Study of Education** Fourth Edition. London. Routledge.

Matheson, C. and Woodward, D (2015) Post-compulsory education (further and higher education). In Matheson, D. (Ed.) **An Introduction to the Study of Education** Fourth Edition. London. Routledge.

Mayhew, D. (2012) In Jacko, J. **The Human-Computer Interaction handbook. Fundamentals, evolving technologies and emerging applications. Third edition.** Boca Raton. CRC Press, Taylor Francis Group. p1182

McClellan, M., Jacko, J., Saintfort, F., and Johnson, M. (2012) Social networks and social media. In Jacko, J. **The Human-Computer Interaction handbook. Fundamentals, evolving technologies and emerging applications. Third edition.** Boca Raton. CRC Press, Taylor Francis Group.

McCormick R. and Li, N. (2006) An evaluation of European learning objects in use. **Learning, Media and Technology** 31(3):pp. 213-231

McGettigan, A. (2013) **The Great University Gamble; money, markets and the future of higher education**. London. Pluto Press.

McHarg, J., Bradley, P., Chamberlain, S. Ricketts, C., Searle, J. McLachlan, J. (2005) Assessment of progress tests. **Medical Education.** 39(2):pp.221-227

McHugh, M. (2012) Interrater reliability: the kappa statistic. **Biochemia Medica.** 22(3):pp.276-282.

McKenny, K. (2011) Using online video to teach nursing skills. **Teaching and Learning in Nursing.** 6(4):pp.172-175

McMorris, L., Gottlieb, N. and Sneden, G. (2005) Developmental stages in public health partnerships: a practical perspective. **Health Promotion Practice.** 6(2):pp.219-226

McMullan, M., Jones, R and Lea, S. (2011) The effect of an interactive e-drug calculations package on nursing students' drug calculation ability and self-efficacy. **International Journal of Medical Informatics.** 80:(6)pp.421-430

McMullan, M., Jones, R. and Lea, S. (2012) Math anxiety, self-efficacy and, ability in British undergraduate nursing students. **Research in Nursing and Health**. 35(2):pp.178-186

Mellor, R. and Woollard, M. (2010) Skill acquisition by health care workers in the Resuscitation Council (UK) 2005 Guidelines for adult basic life support. **International Emergency Nursing.** 18:pp.61-66.

MERLOT (2016) **Peer review information** [online]. Available at: http://info.merlot.org/merlothelp/index.htm#merlot_peer_review_information.htm [Accessed 29 November 2016].

Michinov, E. and Michinov, N. (2007) Identifying a transition period at the midpoint of an online collaborative activity: a study among adult learners. **Computers in Human Behaviour.** 23(3):pp.1355-1371.

Miller, D. (2003) The stages of group development: A retrospective study of dynamic team processes. **Canadian Journal of Administrative Sciences.** 20(2):pp.121-134.

MindShift (2016) **What teachers can gain when students design the lessons** [online]. Available at: http://ww2.kqed.org/mindshift/2016/04/18/what-teachers-can-gain-when-students-design-the-lessons/ [Accessed 29 November 2016].

Mitchell, G (2015) Psychology in education. In Matheson, D. (Ed.) **An Introduction to the Study of Education.** Oxon. Routledge.

Mitka, M. (2003) Peter J. Safar, MD "Father of CPR, "Innovator, Teacher, Humanist **Journal of the American Medical Association.** 289(19):pp.2485-2486.

Monsieurs, K., Vogels, C., Bossaert, L., Meert, P., Manganas, A., Tsiknakis, M., Leisch, E., Calle, P.and Giorgini, F. (2004) Learning effect of a novel interactive basic life support CD: the JUST system. **Resuscitation.** 62(2):pp.159-165

Montgomery, C., Kardong-Edgren, S., Oermann, M. and Odom-Maryon, T. (2012) Student satisfaction and self-report of CPR competency: HeartCode™ BLS courses, instructor-led CPR courses, and monthly voice advisory manikin practice for CPR skill maintenance. **International Journal of Nursing Education Scholarship.** 9(1): Article 10.

Moore, G. (1998). Cramming more components onto integrated circuits. **Proceeding of the IEEE** 86(1):pp 82-85

Morag, R., De Sousa, S., Steen, P., Salem, A., Harris, M. Ohnstad, O., Fosen, J. and Brenner, B. (2005) Performing procedures on the newly deceased for teaching purposes. What if we were to ask? **Archives of Internal Medicine.** 165(1):pp.92-96.

Morris, L. and Connolly, A. (2010) Involving students in the development of evaluation of ubiquitous learning application for a design practice setting. **Ubiquitous Learning.** 2(4):pp.21-38.

Moule, P. (2000) A comparison of different resuscitation guidelines on basic life support performance. **Nursing in Critical Care.** 5(6):pp.273-276

Moule, P. (2002) Evaluation of the basic life support CD-ROM: Its effectiveness as learning tool and user experiences. **Education Technology and Society.** 5(3):pp.163-174.

Moule, P. and Gilchrist, M. (2001) An evaluation of a basic life support CD-ROM. **Health Informatics Journal.** 7(1):pp.29-36.

Moule, P. and Knight, C. (1997) Emergency, cardiac arrest! Can we teach the skills? **Nurse Education Today.** 17(2):pp99-105.

Moule, P., Gilbert, P. and Chalk, V. (2001) A multimedia approach to teaching basic life support – the development of a CD-ROM. **Nurse Education in Practice.** 1(2):pp.73-79.

Moyle, W., Beattie, E., Draper, B., Shum, D., Thalib, L., Jones, C., O'Dwyer, S. and Mervin, C. (2015) Effect of an interactive therapeutic robotic animal on engagement, mood states, agitation and psychotropic drug use in people with dementia: a cluster-randomised controlled trail protocol. **BMJ Open.** 5:e009097. doi:10.1136/bmjopen-2015-009097

Muirhead, R. (2007) E-learning: is this teaching at students or teaching with students? **Nursing Forum**. 42(4):pp.178-184.

Muller, M. and Druin, A. (2012) Participatory Design: The third space in HCI. In Jacko, J. **The Human-Computer Interaction handbook. Fundamentals, evolving technologies and emerging applications. Third edition.** Boca Raton. CRC Press, Taylor Francis Group.

National Student Forum (2009) **Annual Report** [online]. Available at: http://webarchive.nationalarchives.gov.uk/20091223141128/http://www.nationalstudentforum.com/wordpress/wp-content/uploads/2009/10/NSF_annual_report_2009.pdf [Accessed 29 November 2016].

NHS Confederation (undated) **Key statistics on the NHS** [online]. Available at http://www.nhsconfed.org/resources/key-statistics-on-the-nhs [Accessed 29 November 2016].

NMC (2010) **Standards for pre-registration nursing education** [online]. Available at: http://www.nmc.org.uk/globalassets/sitedocuments/nmc-publications/standards-for-pre-registration-nursing-education-16082010.pdf [Accessed 29 November 2016].

NMC (2014) **Conduct and Competence Committee Substantive Hearing** [online]. Available at: http://www.nmc.org.uk/globalassets/sitedocuments/ftpoutcomes/2014/aug/reasons-poole-cccsh--40459-20140818.pdf?_t_id=1B2M2Y8AsgTpgAmY7PhCfg%3d%3d&_t_q=carole+poole&_t_tags=language%3aen%2csiteid%3ad6891695-0234-463b-bf74-1bfb02644b38&_t_ip=128.243.2.153&_t_hit.id=NMC_Web_Models_Media_DocumentFile/_f2d14b1d-02eb-44ab-b224-6667d61ad106&_t_hit.pos=1 [Accessed 29 November 2016].

NMC (2015a) **Guidance on using social media responsibility** [online]. Available at: http://www.nmc.org.uk/globalassets/sitedocuments/nmc-publications/social-media-guidance-30-march-2015-final.pdf [Accessed 29 November 2016].

NMC (2015b) **Read The Code online** [online]. Available at: http://www.nmc.org.uk/standards/code/read-the-code-online/ [Accessed 29 November 2016].

Noble, H. and Smith, J. (2015) Issues of validity and reliability in qualitative research. **Evidence Based Nursing.** 18(2):pp.34-35

Nolan, J. Hazinski, M., Billi, J., Boettiger, B., Bossaert, L., de Caen, A., Deakin, C., Drajer, S., Eigel, B., Hickey, R. et al (2010) Part 1: Executive Summary 2010 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. **Resuscitation.** [online]. 81 Suppl. 1:e1-25. Available at: doi: http://dx.doi.org/10.1016/j.resuscitation.2010.08.002 [Accessed 29 November 2016].

Nolan, J., Soar, J. and Eikland, H. (2006) The chain of survival. **Resuscitation.** 71(3):pp.270-271.

Noldus, L., Trienes, R., Hendriksen, A., Jansen, H. and Jansen, R (2000) The Observer Video-Pro: New software for the collection, management and presentation of time-structured data from videotapes and digital media files. **Behaviour Research Methods, Instruments and Computers** 32(1):pp.197-206.

Norman, G. (2010) Likert scales, levels of measurement and the "laws" of statistics. **Advanced in Health Sciences Education** 15:pp.625-632.

Norton, L. (2009) Assessing student learning. In Fry, H., Ketteridge, S. and Marshall S. **A handbook for teaching and learning in higher education enhancing academic practice.** Third edition. Abingdon: Routledge.

Nyman, J. and Sihvonen, M. (2000) Cardiopulmonary resuscitation skills in nurses and nursing students. **Resuscitation.** 47(2):pp.179-184.

O'Brien, L. (2015) **Evidence-Based Education in the Health Professions.** London. Radcliffe Publishing Ltd.

O'Connor, K. (2014) MOOCs, institutional policy and change dynamics in higher education. **Higher Education**. 68(5):pp.623-635

O'Donnell, C. (1990) A survey of opinion amongst trained nurses and junior medical staff on current practices in resuscitation. **Journal of Advanced Nursing.** 15:pp.1175-1180.

O'Reilly, T. (2007) What is Web 2.0: Design patterns and business models for the next generation of software. **Communications & Strategies.** 65:pp17-37.

Oblinger, D. (2003) Boomers, Gen-Xers and Millennials: understanding the new students [online]. Available at: https://er.educause.edu/articles/2003/1/boomers-genxers-and-millennials-understanding-the-new-students [Accessed 8 February 2018].

Oermann, M., Kardong-Edgren, S. and Odom-Maryon, T. (2011) Effects of monthly practice on nursing students' CPR psychomotor skill performance. **Resuscitation.** 82:pp.447-453.

Oermann, M., Kardong-Edgren, S., McColgan, J. Hurd, D., Haus, C., Snelson, C., Hallmark, B., Rogers, N., Kuerschner, D., Ha, Y., et al (2010a) Advantages and barriers to use of HeartCode™ BLS with voice advisory manikin for teaching nursing students. **International Journal for Nursing Education Scholarship.** [online]. 7(1): Article 26. Available at doi: 10.2202/1548-923X.1949 [Accessed 26 Nov 2016].

Oermann, M., Kardong-Edgren, S., Odom-Maryon, T., Ha, Y., McColgan, J., Hurd, D., Rogers, N., Resurreccion, L., Snelson, C., Kuerschner, D., et al (2010b) HeartCode™BLS with voice assisted manikin for teaching nursing students: preliminary results. **Nursing Education Perspectives.** 31(5):pp.303-308.

Oermann, M., Kardong-Edgren, S., Odom-Maryon, T., Hallmark, B., Hurd, D., Rogers, N., Haus, C., McColgan, J., Snelson, C., Dowdy, S. et al (2011) Deliberate practice of motor skills in nursing education: CPR as exemplar. **Nursing Education Perspectives.** 32(5):pp.311-315.

Office for National Statistics (2016). **Acccesing the internet using a mobile phone, portable computer and/or handheld device, by region, Great Britain coverage 2015** [online]. Available at: https://www.ons.gov.uk/peoplepopulationandcommunity/householdcharacteristics/homeinternetandsocialmediausage/adhocs/005525accessingtheinternetusingamobilephoneportablecomputerandorhandhelddevicebyregiongreatbritaincoverage2015 [Accessed 26 Nov 2017].

Office for National Statistics (2017). **Living Costs and Food Survey. Technical Report for Survey Year April 2015 to March 2016**. Great Britain and Northern Ireland.

Oliver, R. (2007) Reusing and sharing learning designs in higher education. Enhancing Higher Education, Theory and Scholarship, **Proceedings of the 30th HERDSA Annual Conference, , 8-11 July 2007: Adelaide** pp X429.

Oliver, M. (2002) What do learning technologists do? **Innovations in Education and Teaching International.** 39(4):pp.245-252.

Oliver, M. (2010) Setting the scene; E-learning and the evolutionary roles and practices in post compulsory education. In Bromage, A., Clouder, L., Thistlethwaite, J and Gordon, F. **Interprofessional E-Learning and Collaborative Work, Practices and Technologies**. Hershey PA, IGI Global.

Östlund, U., Kidd, L., Wengström, Y. and Rowa-Dewar N. (2011) Combining qualitative and quantitative research with-in mixed methods research designs: A methodological review. **International Journal of Nursing Studies.** 48(3):pp.369-383.

Page, S. and Meerabeau, L. (1996) Nurses account of cardiopulmonary resuscitation. **Journal of Advanced Nursing.** 24(3):pp.317-325.

Pallant, J. (2013) **SPSS Survival Manual. Fifth edition.** Maidenhead. Open University Press.

Palmgren-Neuvonen, L. and Korkeamäki,R. (2014) Group interactions on primary-aged students in the content of a learner-generated digital video production. **Learning, Culture and Social Interaction.** 3(1):pp.1-14

Parahoo, K. (2014) **Nursing research. Principles, processes and issues. Third edition.** Basingstoke. Palgrave Macmillan.

Parisky, A. and Boulay, R. (2013) Designing and developing Open Educational Resources in higher education: A molecular biological project. **International Journal of Technology, Knowledge and Society.** 9(2):pp.145-155

Parkes,D. (2002) Internet editorial. Radical constructivism. **Journal of Workplace Learning.**

Paul, F. (2010) An exploration of student nurses' thoughts and experiences of using a video-recording to assess their performance of cardiopulmonary resuscitation (CPR) during a mock objective structured clinical examination (OSCE). **Nurse Education in Practice.** 10(5):pp.285-290.

Paulin, D. and Gilbert, S. (2016) Social Media and Learning. In **The SAGE Handbook of E-learning Research (Second Edition).** London, SAGE Publications Ltd

Peat, J. (2001) **Health Science Research. A handbook of quantitative methods**. London. SAGE Publications Ltd.

Pegler, C (2013) The influence of open resources on design practice. In Beetham, H. and Sharpe, R. (Eds.) In **Rethinking Pedagogy for a Digital Age.** Abingdon. Routledge.

Perkins, G., Hulme, J. and Bion, J. (2002) Peer-led resuscitation training for healthcare students: a randomised controlled study. **Intensive Care Medicine.** 28(6):pp.698-700.

Perkins, G., Hulme, J., Shore, H. and Bion, J. (1999) Basic life support training for health care students. **Resuscitation.** 41(1):pp.19-23.

Perkins, G., Fullerton, J., Davis-Gomez, N., Davies, R., Baldock, C. Stevens, H., Bullock, I. and Lockey, A. (2010) The effect of pre-course e-learning prior to advanced life support training: A randomised controlled trial. **Resuscitation.** 81(7):pp.877-881.

Petty, G. (2010) Teaching today. A Practical Guide. Fourth Edition. Cheltenham. Nelson Thornes Ltd.

Peyton, J. (1998) **Teaching and Learning in Medical Practice**. Rickmansworth. Manticore Europe Ltd.

Phillips, A., Lewis, L., McEvoy, M., Galipeau, J., Glasziou, P., Moher, D., Tilson, J. and Williams, M. (2016) Development and validation of the guideline for reporting evidence-based practice educational interventions and teaching (GREET). **BMC Medical Education.** 16(237):pp.1-10

Pike, T. and O'Donnell, V (2010) The impact of clinical simulation on learner self-efficacy in pre-registration nursing education. **Nurse Education Today.** 30(5):pp.405-410.

Polit, D. and Beck, C. (2012) Nursing Research. Generating and assessing evidence for nursing practice. Philadelphia. Walters Kluwer Health Lippencott, Williams & Wilkins.

Polit, D. and Yang, F. (2016) **Measurement and the Measurement of Change.** Philadelphia. Wolters Kluwer.

Prensky, M. (2001) Digital natives, digital immigrants. **On The Horizon.** 9(5):pp.1-6.

Prensky, M. (2007) **Changing Paradigms from "being taught" to "learning on your own with guidance**". [online]. Available at: http://www.marcprensky.com/writing/Prensky-ChangingParadigms-01-EdTech.pdf [Accessed 29 November 2016].

PRISMA (2015) Transparent reporting of systematic reviews and meta-analysis [online]. **PRISMA** Available at: http://prisma-statement.org/ [Accessed 29 November 2016].

Ramsden, P. (2003) **Learning to teach in higher education. Second edition.** London. RoutledgeFalmer.

Reisz, M. (2011) **Disciplinary tribalism 'is stifling creativity'** [online]. Available at: https://www.timeshighereducation.com/news/disciplinary-tribalism-is-stifling-creativity/416549.article [Accessed 29 November 2016].

Resuscitation Council (2011) **Advanced Life Support Sixth edition.** London. Resuscitation Council.

Resuscitation Council (2015a) **CPR Guidelines 2015 – ILCOR reviews ready for public comment** [online]. Available at: https://www.resus.org.uk/statements/cpr-guidelines-2015-ilcor-reviews-ready-for-public-comment/ [Accessed 29 November 2016].

Resuscitation Council (2015b) **Video summaries. Education and Implementation of Resuscitation** [online]. Available at: https://www.resus.org.uk/resuscitation-guidelines/g2015-video-summaries/ [Accessed 29 November 2016].

Resuscitation Council (2018) ALS – Advanced Life Support [online]. Available at: https://www.resus.org.uk/information-on-courses/advanced-life-support/ [Accessed 27 February 2018].

Robertson, T. and Simonsen, J. (2012) Participatory Design. An Introduction. In Simonsen & Robertson. **Routledge International Handbook of Participatory Design.** London Routledge.

Rosen, D. and Nelson, C. (2008) Web 2.0: A new generation of learners and education. **Computers in the Schools.** 25(3-4):pp.211-225.

Rosenbaum, B., Gorrindo, T. Patel, S. McTigue, M., Rodgers, S. and Miller B. (2009) Medical student involvement in website development. **Medical Teacher.** 31(7):pp.627-633.

Rowbotham, M. and Owen, R. (2015) The effect of clinical nursing instructors on student self-efficacy. **Nurse Education Today.** 15(6):pp.561-566

Rudestam, K. and Newton, R. (2015) **Surviving your dissertation. A Comprehensive Guide to Content and Process.** Fourth edition. London SAGE Publications.

Rudman, R. and Bruwer, R. (2016) "Defining Web 3.0: opportunities and challenges" **The Electronic Library** 34(1):pp.132-154, https://doi.org/10.1108/EL-08-2014-0140

Sandelowski, M. (1986) The problem of rigor in qualitative research. **Advances in Nursing Science.** 8(3):pp.27-37

Sandelowski, M. (1993) Rigor or rigor mortis: The problem of rigor in qualitative research revisited. **Advances in Nursing Science.** 16(2):pp.1-8

Sandelowski, M., Barroso, J, and Voils, C. (2007) Using qualitative metasummary to synthesize qualitative and quantitative descriptive findings. **Research in Nursing and Health.** 30(1):pp.99-111.

Sandlin, M., Odom, S., Lindner, J. and Dooley, K. (2012) Developing global leadership perspective through the use of student designed reusable learning objects. **Journal of Leadership Studies.** 6(1):pp.79-84.

Sardo, S. and Dal Sasso, G. (2008) Problem-based learning in cardiopulmonary resuscitation: basic life support. **Rev Esc Emferm USP.** 42(4):pp.777-784.

Schcolnick, M., Kol, S. and Abarbanel, J. (2006) Constructivism in theory and in practice. **English Teaching Forum.** 44(4):pp.12-20

Schmidt, H. and Moust, J. (1995) What makes a tutor effective? A structural equations modelling approach to learning in problem-based curricula. **Academic Medicine.** 70(8):pp.708-714.

Schuler, D., Namioka, A. Hillsdale, N. (Eds.) (1993) **Participatory Design: Principles and Practices.** Hillsdale, N.J. Erlbaum Associates.

Schuman, S. (Ed.) (2001) Developmental sequence in small groups. **Group Facilitation. A Research and Applications Journal.** [online]. 3:pp.66-81 Available at: http://openvce.net/sites/default/files/Tuckman1965DevelopmentalSequence.pdf [Accessed 29 November 2016].

Schwab, K. (2015) The Fourth Industrial Revolution; What it means and how to respond. [Online.] **Foreign Affairs** 12 December 2015: Available at: https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution [Accessed 17 December 2017].

Scown, P. (2010) Building a learning community: students teaching students using video podcasts. In: Foster J. **Collaborative Information Behaviour: User Engagement and Communication Sharing.** Hershey, PA. IGI Global.

Sharpe, R., Benfield, G., Lessner, E. and DiCicco, E. (2005) Scoping study for the pedagogy strand of the JISC e-learning programme. [Online]. Available at: https://www.researchgate.net/publication/295400695_Scoping_study_for_the_pedagogy_strand_of_the_Jisc_eLearning_programme [Accessed 5 June 2017].

Sharples, M., MacAndrew, P., Weller, M., Ferguson, R., FitzGerald, E. Hirst, T. and Gaved, M. (2013) Innovating Pedagogy 2013 **Open University Innovation Report 2**. Milton Keynes: The Open University.

Sharples, M., McAndrew, P., Weller, M., Ferguson, R., FitzGerald, E., Hirst, T., Mor, Y., Gaved, M. and Whitelock, D. (2012). Innovating Pedagogy 2012 **Open University Innovation Report 1**. Milton Keynes: The Open University.

Smith, G. (2008) Group development: A review of the literature and a commentary on future research directions. **Group Facilitation.** 3, 14-45

Soar, J., Mancini, M., Bhanji, F., Billi, J., Dennett, J., Finn, J., Ma, M., Perkins, G., Rodgers, D., Hazinski, M. et al. (2010). Part 12: Education, implementation, and teams: 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations [online]. **Resuscitation.** 81(Suppl.1):pp.288-330 Available at: doi:10.1016/j.resuscitation.2010.08.030 [Accessed 11 February 2018].

Steinert, Y., Mann, K., Centeno, A. Dolmas, D., Spencer, J., Gelula, M. and Prideaux, D. (2006) A systematic review of faculty development initiatives designed to improve teaching effectiveness in medical education: BEME Guide 8 [online]. **Best Evidence Medical and Health Professional Education.** Available at: http://www.bemecollaboration.org/Published+Reviews/BEME+Guide+No+8/ [Accessed 29 November 2016].

Streiner, D., Norman, G and Cairney, D. (2015) **Health measurement scales. A practical guide to their development and use. 5th ed**. Oxford. Oxford University Press.

Sternberg, R (2014) Academic tribalism. **The Chronicle of Higher Education** [online:weblog]. Available at: http://chronicle.com/blogs/conversation/2014/02/26/academic-tribalism/ [Accessed 29 November 2016].

Strauss, W. and Howe, N. (1997) **The Fourth Turning. An American Prophecy. What the cycles of history tell us about America's next rendezvous with destiny.** New York. Broadway Books.

Sundgren, M. (2017) Blurring time and place in higher education with bring your own device applications: a literature review. **Education and and Information Technologies.** 22(6):pp3081-3119.

Sutherland, J. (1995) The Johari Window. A strategy for teaching therapeutic confrontation. **Nurse Educator.** 20(3):pp.22-24

Sweet, J. and Ellaway, R. (2010) Reuse as heuristic: from transmission to nurture in learning activity design. **Innovations in Education and Teaching International.** 47(2):pp.215-222.

Sweller, J. (1988) Cognitive load during problems solving: effects on learning. **Cognitive Science.** 12:(2)p.257-285

Szogedi, I., Zrinyi, M., Betlehem, J., Ujvarine, A. and Toth, H (2010) Training nurses for CPR: support for the problem-based approach. **European Journal of Cardiovascular Nursing.** 9(1):pp.50-56.

Tamkin, P., Yarnall, J. and Kerrin, M. (2002) Kirkpatrick and beyond: A review of models of training evaluation [online]. **The Institute for Employments Studies.** Available at: http://www.employment-studies.co.uk/resource/kirkpatrick-and-beyond [Accessed 11 February 2018].

Taylor, B. Kermode, S. and Roberts, K. (2006) **Research in Nursing and Healthcare: Evidence for practice**. South Melbourne, Thompson.

The Open University (2018) Informal learning at The Open University [online]. Available at: http://www.open.ac.uk/about/open-educational-resources/ [Accessed 2 Mar 2018].

Thistlethwaite, J. (2010) Learning Environment**.** In: Cantillon, P. and Wood, D. **ABC of Learning and Teaching in Medicine.** Chichester. Wiley-Blackwell.

Thomas, J. and Richard, J. (2012) Achieving psychological simplicity. Measures and methods to reduce cognitive complexity. In Jacko, J. (Ed) **The Human-Computer Interaction handbook. Fundamentals, evolving technologies and emerging applications. Third edition.** Boca Raton. CRC Press, Taylor Francis Group.

Todhunter, F. (2015) Using principal components analysis to explore competence and confidence in student nurses as users of information and communication technologies: ICT competence and confidence in student nurses. **Nursing Open**. 2(2):pp.72-84

Torgerson, C and Torgerson, D. (2001) The need for randomised controlled trials in educational research. **British Journal of Education Studies.** 49:(3)p.316-328

Transue, B. (2013) Connectivism and information literacy: moving from learning theory to pedagogical practice. **Public Services Quarterly.** 9(3):pp185-195.

Tubbs, S. (2004). **A systems approach to small group interaction (8th ed.).** New York. McGraw-Hill

Tuckman, B. (1965) Developmental sequences in small groups. **Psychological Bulletin.** 63(6):pp.384-399.

Tuckman, B. and Jensen, M. (1977) Stages of small-group development revisited. **Group and Organisational Studies.** 2(4):pp.419-427.

Turner, N., Ellaway, R. and Yewdall, S. (2004) Teaching web authoring: valuable skills, paperless courses. **Medical Teacher.** 26(4):pp.333-335.

Tweed, M. (2006) Letters to the editor. Negative marking can be justified in marking schemes for healthcare professional examinations. **Medical Teacher.** 28(6):pp.579-580.

Uitterhoeve, R., Leeuw, J., Bensing, J., Heaven, C., Borm, G., deMulder, P. and van Achterberg, T. (2008) Cue-responding behaviours of oncology nurses in video-simulated interviews. **Journal of Advanced Nursing.** 61(1):pp.71-80.

University of Nottingham (2010a) **SHOULD** [online]. Available at: http://sonet.nottingham.ac.uk/projects/should/index.html [Accessed 11 December 2016].

University of Nottingham (2010b) **RLO Development: RLO Lifecycle** [online]. Available at: http://www.nottingham.ac.uk/nmp/sonet/rlos/devt/rlo_lifecycle.html [Accessed 29 November 2016].

University of Nottingham (undated a) **Health E-Learning and Media (HELM) Team** [online]. Available at: http://www.nottingham.ac.uk/helm/home.aspx [Accessed 5 June 2017].

University of Nottingham (undated b) **Learning Object Development** [online]. Available at: http://www.nottingham.ac.uk/helm/resources/learning-objects/rlo-development.aspx#Documents [Accessed 29 November 2016].

Vanderbilt University (2015) **Student Portal** [online]. Available at: https://medschool.vanderbilt.edu/portal/ [Accessed 29 November 2016].

Walker, J. and Mather, N. (2004) Working together: a qualitative study of group formation amongst GPs during a cost-driven prescribing initiative. **Family Practice.** 21(5):pp.552-558

Walsh, K. (2015) Big Ideas. Curriculum design: Can we learn from product lifecycle management? Nurse Education Today. 35(8):pp.919-920

Waltz, C., Strickland, O. and Lenz E. (2010) **Measurement in Nursing and Health Research.** Fourth Edition. New York. Springer Publishing Company.

Weber, M. and Karman, T. (1991) Student group approach to teaching using Tuckman model of group development. **American Journal of Physiology.** 261(6Pt 3):S12-S16.

Weiser, M. (1991) The computer for the 21st century. **Scientific American.** 265(3):pp.66-75

Wharrad, H. and Windle, R. (2010) In Bromage, A., Clouder, L., Thistlethwaite, J and Gordon, F. **Interprofessional E-Learning and Collaborative Work, Practices and Technologies**. Hershey PA, IGI Global.

Wharrad, H., Kent, C., Allcock, N. and Wood, B. (2001) A comparison of CAL with conventional methods of delivery of cell biology to undergraduate nursing students using an experimental design. **Nurse Education Today.** 21(7):pp. 579-588

Wheelan, S., Davidson, B. and Tilin, F. (2003) Group development across time. Reality or illusion? **Small Group Research.** 34(2):pp.223-245

Wheeler, S. (2016) **Learning with 'e's**. Carmarthen, Wales. Crown House Publishing

Whitfield, R., Newcombe, R. and Woollard, M. (2003) Reliability of the Cardiff Test of basic life support and automated defibrillation version 3.1. **Resuscitation.** 59(3):pp.291-314

Wikipedia (2013) **IMS Learning Design** [online]. Available at: https://en.wikipedia.org/wiki/IMS_Learning_Design [Accessed 29 November 2016].

Wikipedia (2018) **Generation** [online]. Available at: https://en.wikipedia.org/wiki/Generation#Generational_theory [Accessed 8 February 2018].

Wiley, D. (2000) Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy. In Wiley D. (Ed) **The Instructional Use of Learning Objects.**[online]. Available at: http://www.reusability.org/read/#1 [Accessed 22 Noovember 2017].

Williams, A. Windle, R. and Wharrad, H. (2012) Student vs. teacher e-learning development approaches. **The Fourth European Articulate Conference.** University of Leeds, 24 May 2012. Leeds.

Williams, A., Wharrad, H. and Windle, R. (2015) **How are storyboards created by students and tutors for the development of reusable learning objects?** [online]. Available at: https://altc.alt.ac.uk/2015/sessions/how-are-storyboards-created-by-students-and-tutors-for-the-development-of-reusable-learning-objects-833/members/www.xtlearn.net/ [Accessed 29 November 2016].

Williams, A., Windle, R. and Wharrad, H. (2014) Student generated and tutor generated web based resuscitation education resources – Mind the gap? **Resuscitation.** 85(Suppl. 1):pp.S60

Windle, R. and Wharrad, H. (2010) In Bromage, A., Clouder, L., Thistlethwaite, J and Gordon, F. **Interprofessional E-Learning and Collaborative Work, Practices and Technologies**. Hershey PA, IGI Global.

Windle, R. McCormick, D. Dandrea, J. and Wharrad, H. (2011) The characteristics of reusable learning objects that enhance learning: A case-study in health-science education. **British Journal of Educational Technology** 42(5):pp.811-823.

Windle, R., Wharrad, H., Leeder, D. and Morales, R. (2007) Analysis of the pedagogical attributes of learning objects [online]. Available at: http://www.nottingham.ac.uk/nursing/sonet/projects/loam/load/docs/edmedia-final.pdf [Accessed 29 November 2016].

Woollard, J. (2011) **Psychology for the classroom: e-learning.** Abingdon. Routledge.

Woolmer, C., Sneddon, P., Curry, G., Hill, B., Fehertavi, S., Longbone, C. and Wallace, K. (2016) Student staff partnership to create an interdisciplinary science skills course in a research intensive university. **International Journal for Academic Development.** 21(1):pp16-27

World Wide Web Foundation (2015) **Sir Tim Berners-Lee** [online]. Available at: http://webfoundation.org/about/sir-tim-berners-lee/ [Accessed 29 November 2016].

Wynne, G., Marteau, T., Johnson, M., Whiteley, C. and Evans, T. (1987) Inability of trained nurses to perform basic life support. **British Medical Journal.** 249(6581):pp.1198-1199.

Yakel, M. (1989) retention of cardiopulmonary resuscitation skills among nursing personnel: what makes the difference? **Heart and Lung.** 18(5):pp.520

Zulkosky, K. (2009) Self-efficacy: A concept analysis. **Nursing Forum.** 44(2):pp.93-102

8 Appendices

8.1 Summary of Resuscitation Training Search Literature

Author	Title	Resuscitation Training Method[11] (see footnote for key)	Participants	Findings
Ackermann (2009)	Investigation of learning outcomes for the acquisition and retention of CPR knowledge and skills learned with the use of high-fidelity simulation.	Sim.	Junior nursing students n=49.	High fidelity simulation results in significantly improved knowledge and skill acquisition and retention after three months.
Bowden et al (2012)	Web-based video and feedback in the teaching of cardiopulmonary resuscitation	Online	Nursing students n=14, tutors n=3	Reviewing web-based video feedback appreciated by all participants.
Bruce et al (2009)	A collaborative exercise between graduate and undergraduate nursing students using a computer-assisted simulator in a mock cardiac arrest	Sim	Registered nurses n=11, nursing students n=109	For nursing students simulation education significantly improved knowledge though not confidence.
Cason & Baxley (2011)	Learning CPR with BLS Anytime™ for Healthcare Providers Kit	Online	Tutors n=49 and nursing students n=39	Commercially available online education provided effective accessible initial and refresher resuscitation training.
Cook et al (2012)	Impact of a web based interactive simulation game (PULSE) on nursing students' experience and performance in life support training — A pilot study	Online	Nursing students n=34	Web-based education was well received and significantly enhanced aspects resuscitation related knowledge.
Davies & Gould (2000)	Updating cardiopulmonary resuscitation skills: a study to examine the efficacy of self-instruction on nurses' competence	Self-ins.	Nursing students, n=20	Self-instruction is a viable intervention when learning resuscitation.
Greig et al (1996)	Basic life support skill acquisition and retention in student nurses undertaking a pre-registration diploma in higher education/nursing course	Self-ins.	Nursing students, n=72	Small group and repeated practice enhanced the learning of resuscitation.

[11] **CD** = CD-ROM; **Online** = online, feedback and short repeated practice; **Peer** = peer instruction; **Self-ins.** = self-instruction, small group and problem based learning; **Sim.** = simulation

Author	Title	Resuscitation Training Method[11] (see footnote for key)	Participants	Findings
Leighton & Scholl (2009)	Simulated Codes: Understanding the response of undergraduate nursing students	Sim	Nursing students, n=28	Simulation increased the confidence of participants when deploying resuscitation techniques.
Monsieurs et al (2004)	Learning effect of a novel interactive basic life support CD: the JUST system	CD	Junior nursing students, n=62	The use of a CD-ROM encouraged participants to assist in a resuscitation though their ability was not significantly improved.
Montgomery et al (2012)	Student satisfaction and self-report of CPR competency: HeartCode™ BLS courses, instructor-led CPR courses, and monthly voice advisory manikin practice for CPR skill maintenance	Online	Nursing students, n=606	Participants preferred a blended learning approach and monthly practice enhanced confidence.
Moule (2002)	Evaluation of the basic life support CD-ROM: Its effectiveness as learning tool and user experiences	CD	Nursing students, used CD-ROM n=358; BLS skills teaching, n = 88; focus group interviews n=26.	CD-ROM use was not a factors in skill acquisition and e-learning interventions require clear aims and objectives.
Moule & Gilchrist (2001)	An evaluation of a basic life support CD-ROM	CD	Nursing students, n=26	Participants felt a CD-ROM prepared them for BLS practice sessions.
Moule et al (2001)	A multimedia approach to teaching basic life support – the development of a CD-ROM	CD	Not applicable.	Report of project to develop CD-ROM delivered resuscitation training.
Oermann et al (2010)	HeartCode™BLS with voice assisted manikin for teaching nursing students: preliminary results	Online	Nursing students, n= 603	Students learning resuscitation using computer-aided learning and manikin feedback were significantly more accurate when delivering BLS interventions.
Oermann et al (2011)	Deliberate practice of motor skills in nursing education: CPR as exemplar	Online	Nursing students, n= 606	Short regular CPR practice resulted in significantly improved performance.
Paul (2010)	An exploration of student nurses' thoughts and experiences of using a video-recording to assess their performance of cardiopulmonary resuscitation (CPR) during a mock objective structured clinical examination (OSCE).	Online	Nursing students on accelerated programme, n=14	Video provides additional feedback on participants' performance though Additional practice and support may be required when initially learning resuscitation.

Author	Title	Resuscitation Training Method[11] (see footnote for key)	Participants	Findings
Perkins et al (1999)	Peer-led resuscitation training for healthcare students: a randomised controlled study	Peer	Health professional students, n=354	Reports student peer teaching programme and very positive participant reaction evaluations
Perkins et al (2002)	Peer-led resuscitation training for healthcare students: a randomised controlled study	Peer	Health professional students, n=119	Reports effectiveness of resuscitation training significantly favouring student delivered teaching.
Sardo & Dal Sasso (2008)	Problem-based learning in cardiopulmonary resuscitation: basic life support	Self-ins.	Nursing students, n=24	Report of problem based learning approach to resuscitation training and participant reaction.
Szogedi et al (2010)	Training nurses for CPR: support for the problem-based approach	Self-ins.	Nursing students, n=1775	Analysis of problem based learning and standard instruction of resuscitation, based on final examination grade awarded.

8.2 Summary of LO Search Literature

Author	Title	Methodology & Intervention or Discussion	Participants	Findings	Kirkpatrick Level
Abbot (2010)	Delivering quality-evaluated healthcare information in the era of Web2.0: design implications for Intute: Health and Life Sciences.	Comment article. Web2.0	Not applicable.	Discussion how the development of user generated content requires a quality control mechanism.	Not applicable.
Anderson & Wark (2004)	Why do teachers get to learn the most?	Primary research. Survey. General e-learning interventions, including use of a VLE.	Master's in Distance Education students, n=17	Student designed resources valued and cost effective, though support in real-time and asynchronously is necessary. Anxiety from awaiting other contributions noted with cohort perhaps not reflective of wider student population.	1
Chang et al (2008)	Web2.0 and user-created content: Students negotiating shifts in academic authority.	Primary research. Focus group with semi-structured interview. Podcasting.	Medical students, n=4	Three themes identified with resistance to move from teacher to student led knowledge creation, determining the teacher/student views on content and benefits of peer learning.	1
Furmedge et al (2014)	Peer-assisted learning – Beyond teaching: How can medical students contribute to the undergraduate curriculum?	Report of five case studies VLE, video, OSCE Preparation, student views on mental health & peer mentor.	Not specified	Demonstrated student designed case studies are feasible and accessed though sparse engagement data reported and no formal evaluation of acceptability or learning	1
Guler & Altun (2010)	Teacher trainees as learning object designers: problems and issues in learning object development process.	Design based research reporting qualitative data. Website.	Trainee teachers, n= 49, in twelve project groups working in groups of three or four.	Themes of LO development ranked from interviews with qualitative comment from participants.	1

Author	Title	Methodology & Intervention or Discussion	Participants	Findings	Kirkpatrick Level
Harden (2005)	A new vision for distance learning and continuing medical education.	Comment article. Potential for virtual medical school.	Not applicable.	Discusses how a virtual medical school comprising many facets of e-learning (RLOs, self-assessments, "ask-the-expert" and peer learning) can provide continuing medical education.	Not applicable.
Jesse et al (2006)	Reusable learning units: an innovative teaching strategy for online nursing education.	Comment article Report of use of RLOs in nurse education.	Not applicable.	Report of RLO use in USA university offering distance nursing and midwifery education.	Not applicable.
Keating et al (2013)	How we created a peer-designed specialty-specific selective for medical students career exploration.	Primary research. Survey. Student designed non-digital resources.	Undergraduate medical students, n=28.	Student designed "selective" encouraged participants to consider a career in that specialty.	1
Keefe & Wharrad (2012)	Using e-learning to enhance nursing students' pain management education.	Primary research. Quantitative evaluation of knowledge acquisition. RLO.	Undergraduate nursing students, n=206.	A student designed RLO significantly enhanced pain management knowledge acquisition.	2
Kurivolas et al (2014)	Expert centred vs learner centred approach for evaluating quality and reusability of learning objects.	Comment article. Proposed RLO evaluation methodology.	Not applicable.	This paper proposes a methodology to evaluate the quality and reusability of RLOs, highlighting the learner role (referred to as bottom-up) and from an expert view (top-down).	Not applicable.
Morris & Connolly (2010)	Involving students in the development of evaluation of ubiquitous learning application for a design practice setting.	Case study reporting use of ubiquitous reusable learning application. Ubiquitous computing (mobile technology and applications).	Development of URLA, n=2 Master's level design students; Use of URLA, n=30 Master's level design students.	Ubiquitous computing facilitates design students interaction with peers when learning. Comment that tutor observation, survey and interviews support approach though no details provided.	None
Rosenbaum et al (2009)	Medical student involvement in website development.	Primary research. Survey. VLE.	Undergraduate medical students, n=348.	The participants reported a high degree of acceptability of many features demonstrated by usage and Likert scale responses.	1

Author	Title	Methodology & Intervention or Discussion	Participants	Findings	Kirkpatrick Level
Sandlin (2012)	Developing global leadership perspective through the use of student designed reusable learning objects.	Primary research. Phenomenological investigation. RLO.	Students undertaking leadership abroad study, n=20.	Students were asked to "preflect" *(sic)* identifying what knowledge they may gain and reported a greater understanding of developing countries populations, with the RLO creation capturing their experience for peers.	1
Scown (2010)	Building a learning community: students teaching students using video podcasts.	Case study with descriptive statistics. Pod & video casting.	Undergraduate business students on elective, n=not given.	The students undertook traditional assessment (assignment) or created a video or podcast, with result compared. Very limited detail or methodology hinders drawing conclusions.	None
Sweet & Ellaway (2010)	Reuse as heuristic: from transmission to nurture in learning activity design.	Case study reporting student designed education projects. RLO digital and non-digital.	Undergraduate dental students, n=54, working in groups of three or four.	The majority of projects rates more than satisfactory and none rated less than satisfactory, with student reflections on the process.	1
Turner et al (2004)	Teaching web authoring: valuable skills, paperless courses.	Case study and survey. Website development.	Undergraduate medical students, n= 117, working in groups of three or four.	Student appear able to design and develop websites for learning.	1

8.3 Volunteer Information sheet (phase 1)

Division of Nursing
School of Nursing, Midwifery and Physiotherapy
University of Nottingham
London Road Community Hospital
DERBY
DE1 2QY

The University of Nottingham

A comparison of the design and effectiveness of resources created by students and tutors for teaching resuscitation.

Name of Investigators:
Mr Alan R. Williams, Dr Richard Windle, Dr Heather Wharrad

Volunteer's Information Sheet- Phase one student

You have been invited to take part in a research study. Before you decide whether to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends and relatives if you wish to. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part or not. If you decide to take part you may keep this leaflet. Thank you for reading this.

Background

Registered Nurses have not been able to deliver effective resuscitation when tested on manikins. A number of factors have been suggested as to why this occurs and one is that the skills are not initially learnt. As the content necessary to deliver effective resuscitation is determined by international consensus, we wish to investigate how resources used to deliver this knowledge are created.

It is possible that the available resources are not designed to suit the needs of the learners. The way content is presented and the approaches used to teach can have a very large impact on the gaining and retention of knowledge used with skills.

This research project has been designed to investigate how students and how tutors create web-based educational resources (phase one). From the workshop resources will be developed by the research team and media developers. Then first year student nurse will view one resource, undertake knowledge assessments and evaluate that specific resource (phase two). The resource will acknowledge your contribution and be available under a Creative Commons Licence for educational use. When the research project has finished all participants will have access to both resources.

You have been asked to participate in phase one of the project. You will work with four other self-selected students to create a resource that first year student nurses can use to learn about basic life support. You will be contributing ideas for the student created resource based on the 2010 Resuscitation Guidelines. Tutors will also work from the same guidelines and it is any differences in the resource creation process we wish to identify. You may have an interest in e-learning and/or resuscitation, though this is not essential. If you have been closely involved in developing e-learning resources, please tell the research team as this may exclude you from participating.

Your involvement will be at a one day (10am - 4pm) workshop held in the Learning Laboratory, B Floor, Division of Nursing at QMC, Nottingham (see figure one). Travel expenses, refreshments and lunch will be provided. The workshop will be recorded by two small wall mounted video/audio cameras so we are able to identify important factors in the creation process. We will also conduct a short interview with-in three weeks of the

workshop to discuss what you feel is important to consider when designing web-based educational resources.

Figure one – Learning Laboratory.

All audio and video data relating to the Learning Laboratory day will be stored on the University secure network and associated paper records will be stored in a locked filing cabinet according to University policy. Data will be anonymised and only viewed by members of the research team, unless separate permission is requested by us **and** given by you. Anonymous data may be included in publication though any identification of individuals participating in the research will be avoided. According to University policy the data will be held securely on a password protected network or locked filing cabinet for seven years and then destroyed.

There are no risks to you in participating in this research. The disadvantage of taking up your time should be outweighed by refreshing your knowledge of the new 2010 Resuscitation Guidelines and about e-learning methods.

What if something goes wrong?/Who can I complain to.

In case you have a complaint about the staff involved in this research project or anything to do with the study, you can initially approach the lead investigator. If this achieves no satisfactory outcome, you should then contact the Ethics Committee Secretary, Mrs Louise Sabir, Division of Therapeutics and Molecular Medicine, D Floor, South Block, Queen's Medical Centre, Nottingham, NG7 2UH. Telephone 0115 8231063. E-mail louise.sabir@nottingham.ac.uk.

In the unlikely event that you suffer injury to yourself or damage to your property as a result in taking part in this research, the University does have an insurance policy to cover harm arising as a result of the defect in the design of the study.

Will my taking part in this study be kept confidential?

All information which is collected about you during the course of the research will be kept on a password protected database and is strictly confidential. Any information about you which leaves the research unit will have your name and address removed so that you cannot be recognised from it.

What will happen to the results of the research study?

Phase one of the research project will be from Spril 2011 until Summer 2011 and phase two of the project will be from Autumn 2011 until Spring 2012, when all data collection should be complete. We expect results to be available towards the end of 2012 and be published in nursing, educational and inter-professional journals. If you would like to be informed when the results are published please tell one of the research team. In addition we expect to present our work at regional meetings, national and international conferences on e-learning and nurse education. Individuals will not be identified in any report or public presentation of the work.

Who is organising and funding the research?

An application will be made to the Resuscitation Council and other funding bodies to cover the costs of developing the resources for use in phase two of the research project.

Who has reviewed the study?

This study has been reviewed and approved by the University of Nottingham Medical School Ethics Committee.

Contact for Further Information

Thank you

Alan R. Williams
Lecturer, School of Nursing, (University of Nottingham)
London Road Community Hospital
DERBY DE1 2QY
Alan.williams@nottingham.ac.uk
01332 724949

8.4 Volunteer Consent Form (phase 1)

University of Nottingham
School of Nursing, Midwifery and Physiotherapy
Divison of Nursing

The University of Nottingham

Title of Project:
A comparison of the design and effectiveness of resources created by students and tutors for teaching resuscitation. Part One

Name of Investigators: Mr Alan Williams, Dr Richard Windle, Dr Heather Wharrad

Volunteer's Consent Form

Please read this form and sign it once the above named or their designated representative, has explained fully the aims and procedures of the study to you

- I voluntarily agree to take part in this study.
- I confirm that I have been given a full explanation by the above named and that I have read and understand the information sheet given to me which is attached.
- I have been given the opportunity to ask questions and discuss the study with one of the above investigators or their deputies on all aspects of the study and have understood the advice and information given as a result.
- I agree to the above investigators contacting my university authority to make known my participation in the study where relevant.
- I agree to comply with the reasonable instructions of the supervising investigator and will notify him immediately of any unexpected unusual symptoms or deterioration of health.
- I authorise the investigators to disclose the results of my participation in the study but not my name.
- I understand that information about me recorded during the study will be kept in a secure database. If data is transferred to others it will be made anonymous. Data will be kept for 7 years after the results of this study have been published.
- I understand that I can ask for further instructions or explanations at any time.
- I understand that I am free to withdraw from the study at any time, without having to give a reason for withdrawing.

Name: .....

Address: .....

Telephone number: .....

Signature: ..... **Date:** .....

I confirm that I have fully explained the purpose of the study and what is involved to:

.....

I have given the above named a copy of this form together with the information sheet.

Investigators Signature: ..... **Date:** 7th November 2011

Investigators Name: Mr. Alan R. Williams

Study Volunteer Number: .....

8.5 Volunteer Information Form (phase 2)

Division of Nursing
School of Nursing, Midwifery and Physiotherapy
University of Nottingham
London Road Community Hospital
DERBY
DE1 2QY

The University of Nottingham

A comparison of the design and effectiveness of resources created by students and tutors for teaching resuscitation.

Name of Investigators:
Mr Alan R. Williams, Dr Richard Windle, Dr Heather Wharrad

Volunteer's Information Sheet Phase two

You have been invited to take part in a research study. Before you decide whether to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with friends and relatives if you wish to. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether you wish to take part or not. If you decide to take part you may keep this leaflet. Thank you for reading this.

Background

Registered Nurses have not been able to deliver effective resuscitation when tested on manikins. A number of factors have been suggested as to why this occurs and one is that the skills are not initially learnt. As the content necessary to deliver effective resuscitation is determined by international consensus, we wish to investigate how the resources used to deliver this knowledge are created.

It is possible that the available resources are not designed to suit the needs of the learners. It has been shown that the way that content is presented and the approaches used to teach can have a very large impact on the gaining and retention of knowledge used with skills (Makany, Engelbrecht,Meadmore et al 2007). This can be highly specific to a particular group of learners based on cultural influences within that group or profession (REF).

The research project has been designed to investigate how students and how tutors create web-based educational resources (part one). From the workshop the resources will be developed by the research team and media developers. Then first year student nurse will view one resource, undertake knowledge assessment and evaluate that specific resource (part two). When the research project has finished all participants will have access to both resources

You have been asked to participate in **part two** of the project. You have been randomly allocated either the student or the tutor generated resource but you will not know which one until after all data has been collected. Your involvement will consist of:

1. completing a short knowledge assessment before
2. watching a web-based educational resource
3. another knowledge assessment after you view the resource
4. evaluating the resource
5. a final knowledge assessment three months later

The knowledge assessment will be 10 multiple choice questions and will have no bearing on your progress on the course. You answers will only be known to the research team.

You will receive immediate automated feedback after you complete each knowledge assessment. The resource, all assessments and the evaluation will be on WebCT (the University Virtual Learning Environment) that you will be regularly accessing for your course.

All data relating to you will be stored on the University secure network and associated paper records will be stored in a locked filing cabinet according to University policy. Data will be anonymised and only viewed by member of the research team. Anonymous data may be included in publication though any identification of individuals participating in the research will be avoided. According to University policy the data will be held securely on a password protected network or locked filing cabinet for seven years and then destroyed.

There are no risks to you in participating in this research. The disadvantage of taking up your time should be outweighed by accessing an educational resource on the 2010 Resuscitation Guidelines. You will be able to access the resource before a teaching session that is part of you course though not formally assessed. You will be asked to provide consent electronically by using your University username and password and are free to withdraw from the research at any time without affecting your course. You will be able to continue viewing the resource you have been allocated even though you have withdrawn from participating in the research.

What if something goes wrong?/Who can I complain to.

In case you have a complaint about the staff involved in this research project or anything to do with the study, you can initially approach the lead investigator. If this achieves no satisfactory outcome, you should then contact the Ethics Committee Secretary, Mrs Louise Sabir, Division of Therapeutics and Molecular Medicine, D Floor, South Block, Queen's Medical Centre, Nottingham, NG7 2UH. Telephone 0115 8231063. E-mail louise.sabir@nottingham.ac.uk.

In the unlikely event that you suffer injury to yourself or damage to your property as a result in taking part in this research, the University does have an insurance policy to cover harm arising as a result of the defect in the design of the study.

Will my taking part in this study be kept confidential?

All information which is collected about you during the course of the research will be kept on a password protected database and is strictly confidential. Any information about you which leaves the research unit will have your name and address removed so that you cannot be recognised from it.

What will happen to the results of the research study?

The project will continue until spring 2012 when all data collection should be complete. After data collection is complete all participants will be able to access the student created and the tutor created resource. You should be able to identify which resource you were allocated though please contact Alan Williams if you are unsure and wish to know. We expect results to be available towards the end of 2012 and be published in nursing, educational and inter-professional journals. If you would like to be informed when the results are published please tell one of the research team. In addition we expect to present our work at regional meetings, national and international conference on e-learning and nurse education. Individuals will not be identified in any report or public presentation of the work.

Who is organising and funding the research?

An application will be made to the Resuscitation Council and other funding bodies to cover the costs of developing the resources for use in the research project.

Who has reviewed the study?

This study has been reviewed and approved by the University of Nottingham Medical School Ethics Committee.

Contact for Further Information

Thank you

Alan R. Williams
Lecturer, School of Nursing, (University of Nottingham)
London Road Community Hospital
DERBY DE1 2QY
Alan.williams@nottingham.ac.uk
01332 724949

Makany, T., Engelbrecht, P. Meadmore, K., Dudley, R., Redhead, E., and Dror,I. 2007 Giving the learner control of navigation: cognitive gains and losses. [online]. Available at:http://scholar.google.co.uk/scholar?q=Giving+the+learners+control+of+navigation%3A+Cognitive+gains+and+losses&hl=en&btnG=Search&as_sdt=1%2C5&as_sdtp=on [Accessed 19 February 2011].

8.6 Volunteer Consent Form - Participants (phase 2)

University of Nottingham
School of Nursing, Midwifery and Physiotherapy
Divison of Nursing

The University of Nottingham

Title of Project:
A comparison of the design and effectiveness of resources created by students and tutors for teaching resuscitation. Part Two

Name of Investigators: Mr Alan Williams, Dr Richard Windle, Dr Heather Wharrad

Volunteer's Consent Form

Please read this form and sign it once the above named or their designated representative, has explained fully the aims and procedures of the study to you

- I voluntarily agree to take part in this study.
- I confirm that I have been given a full explanation by the above named and that I have read and understand the information sheet given to me which is attached.
- I have been given the opportunity to ask questions and discuss the study with one of the above investigators or their deputies on all aspects of the study and have understood the advice and information given as a result.
- I agree to the above investigators contacting my university authority to make known my participation in the study where relevant.
- I agree to comply with the reasonable instructions of the supervising investigator and will notify him immediately of any unexpected unusual symptoms or deterioration of health.
- I authorise the investigators to disclose the results of my participation in the study but not my name.
- I understand that information about me recorded during the study will be kept in a secure database. If data is transferred to others it will be made anonymous. Data will be kept for 7 years after the results of this study have been published.
- I understand that I can ask for further instructions or explanations at any time.
- I understand that I am free to withdraw from the study at any time, without having to give a reason for withdrawing.

Electronic Consent

As it is proposed to gain consent electronically this will be part of WebCT. Alan Williams will discuss in detail with the University Learning Team and inform the Ethics Committee should there be any technical difficulties.

I confirm I have read the information about the study and am happy to participate in the research. ☑

Investigators Signature: *Insert signature here* **Date:** *Auto complete?*

Investigators Name: Mr. Alan R. Williams

8.7 Confirmation of ethical approval

Direct line/e-mail
+44 (0) 115 8231063
Louise.Sabir@nottingham.ac.uk

The University of Nottingham
Faculty of Medicine and Health Sciences

Medical School Research Ethics Committee
Division of Therapeutics & Molecular Medicine
D Floor, South Block
Queen's Medical Centre
Nottingham
NG7 2UH

Tel: +44 (0) 115 8231063
Fax: +44 (0) 115 8231059

19th July 2011

Dr Alan Williams
Lecturer, School of Nursing, Midwifery & Physiotherapy
Education Centre
London Road Community Hospital
London Road
DE1 2QY

Dear Dr Williams

Ethics Reference No: C/01/2011 - ***Please quote this number on all correspondence***
Study Title: A comparison of the design and effectiveness of resources created by students and tutors for teaching resuscitation.
Lead Investigator: Dr Richard Windle, Associate Professor
Co Investigators: Dr Alan R Williams, Lecturer, School of Nursing, Midwifery & Physiotherapy,Dr Heather Wharrad, Reader, School of Nursing Midwifery & Physiotherapy.

Thank you for your letter dated 5th July 2011 notifying the committee of the following amendments to the above study:

- Introduction of Inconvenience allowance of £30 to participate in phase 1 of the project.
- To allow participating student to be able to use participation in Phase 1 towards achieving outcomes 4.2.1 and 4.2.2 as outlined in the enclosed appendix should they be on placement.

These have been reviewed and are satisfactory and the study amendments are approved.

Approval is given on the understanding that the Conditions of Approval set out below are followed.

Conditions of Approval

You must follow the protocol agreed and any changes to the protocol will require prior Ethic's Committee approval.

This study is approved for the period of active recruitment requested. The Committee also provides a further 5 year approval for any necessary work to be performed on the study which may arise in the process of publication and peer review.

You promptly inform the Chairman of the Ethic's Committee of

(i) Deviations from or changes to the protocol which are made to eliminate immediate hazards to the research subjects.

(ii) Any changes that increase the risk to subjects and/or affect significantly the conduct of the research.

(iii) All adverse drug reactions that are both serious and unexpected.

(iv) New information that may affect adversely the safety of the subjects or the conduct of the study.

(v) The attached End of Project Progress Report is completed and returned when the study has finished.

Yours sincerely

Dr Clodagh Dugdale
Chair, Nottingham University Medical School Research Ethics Committee

8.8 Recruitment Flyers

Storyboard Workshop (phase 1)

NEW DATES - NOVEMBER 2011

Would you like to take part in creating an e-learning resource to teach first year student nurses basic life support?

An opportunity for students to contribute to the development of e-learning

If you are in year two, three or four of a
pre-registration nursing course read on.....

Participation would involve a morning workshop
at QMC, Nottingham with four other students where you will be observed and a short interview at your local Centre to identify factors associated with the resource creation process. We want to investigate the design process so the workshop will be recorded.

Benefit of participating.

- Valuable revision of the new 2010 Resuscitation Guidelines
- Experience in creating e-learning material and team work.
- A Certificate of Participation will be provided.
- A published resource to add to your CV

Ethical approval has been granted. Travel, refreshments and a £30 inconvenience allowance (cash/Amazon/iTunes voucher) will be provided.

NO EXPERIENCE IN E-LEARNING IS REQUIRED.

For more details, please contact:

Alan Williams
Lecturer
School of Nursing
University of Nottingham (Derby Centre)
01332 724949
Alan.Williams@nottingham.ac.uk
Text 0793 204 7086

Z:\Professional Development\DHSci\Phase 1\05a DHSci Advert Part One Version 1 1 Student Nov.docx 14 May 2015

Learning and Evaluation (phase 2)

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

RESEARCH INTO EDUCATIONAL METHODS.

Dear Student,

I am a Lecturer in the Division of Nursing, undertaking research into the creation and development of web-based educational resources (more commonly called Reusable Learning Objects or RLOs), by students and by tutors.

The research has been approved by the Faculty of Medicine and Health Science Ethics Committee (Ref C/01/2011) and the data collected will only be used for the research purposes and not as part of your course assessment. Participation is entirely optional with the individual results remaining confidential and available only to the research team. The RLO will provide you an additional resource to learn about resuscitation before your formal session on Thursday 26th or Friday 27th September 2013. The collection of data for research will close at 4pm on Thursday 26th September, though the RLO will still be available.

An email should be in your University account with a link to an RLO on resuscitation. You will receive a link to either the student or the tutor created resource; it is entirely random which resource you will be able to view. You will be asked to complete a knowledge assessment before and after viewing the resource and provide brief comments. The whole process including viewing the resource should take no longer than 15-20 minutes and I would be grateful if you would only complete the knowledge and evaluation questions the first time you view the resource. The knowledge assessments may take some seconds to load and you may wish to use personal headphones to listen to the audio. Afterwards you are welcome to view the RLO as many times as you wish. There is no certificate as suggested in the RLO though the Basic Emergency Care sessions will provide you plenty of written information on the subject.

Thank you for reading this and I wish you well for you study at the University of Nottingham. If you have any questions you are welcome to contact me on my student email address below.

Alan R. Williams
3rd Jan 2014
ntxaw4@nottingham.ac.uk

8.9 Pilot Knowledge Assessment

Pilot Knowledge assessment - 10 item question paper

1	If you find a person collapsed in a public place, you should first check if they have a pulse.	T / F
2	If a collapsed person does not respond turn them on their side into the recovery position.	T / F
3	If a collapsed person does not respond to you, find another person to establish what has happened.	T / F
4	If you find a person collapsed, first check if they their airway is blocked with vomit.	T / F
5	The head tilt/chin lift is an effective method of moving the tongue away from the back of the throat.	T / F
6	If a person is not breathing you should turn them into the recovery position.	T / F
7	When checking for breathing you should also look for signs of life.	T / F
8	When a person is in cardiac arrest you should check for a pulse every 30 seconds.	T / F
9	You should press down approximately five to six centimetres on the chest when performing chest compressions.	T / F
10	Cardiac arrest is confirmed when a collapsed person is not breathing and there are no signs of life.	T / F

Pilot Knowledge assessment - 15 item question paper

1	If you find a person collapsed in a public place, you should first check if they have a pulse.	T / F
2	If a collapsed person does not respond turn them on their side into the recovery position.	T / F
3	If a collapsed person does not respond to you, find another person to establish what has happened.	T / F
4	If you find a person collapsed, first check if they their airway is blocked with vomit.	T / F
5	The head tilt/chin lift is an effective method of moving the tongue away from the back of the throat.	T / F
6	If a person is not breathing you should turn them into the recovery position.	T / F
7	When checking for breathing you should also look for signs of life.	T / F
8	When a person is in cardiac arrest you should check for a pulse every 30 seconds.	T / F
9	You should press down approximately five to six centimetres on the chest when performing chest compressions.	T / F
10	Cardiac arrest is confirmed when a collapsed person is not breathing and there are no signs of life.	T / F
11	In most circumstances the risk of harm to the rescuer whilst resuscitating an individual is high.	T / F
12	On finding a person collapsed you should first check if they have a pulse.	T / F
13	If a person collapses near to you, first check their airway is clear and open.	T / F
14	You should deliver five breaths when you establish the person is not breathing.	T / F
15	Chest compressions are performed at a rate of 60 compressions per minute.	T / F

Pilot Knowledge assessment - 20 item question paper

1	If you find a person collapsed in a public place, you should first check if they have a pulse.	T / F
2	If a collapsed person does not respond turn them on their side into the recovery position.	T / F
3	If a collapsed person does not respond to you, find another person to establish what has happened.	T / F
4	If you find a person collapsed, first check if they their airway is blocked with vomit.	T / F
5	The head tilt/chin lift is an effective method of moving the tongue away from the back of the throat.	T / F
6	If a person is not breathing you should turn them into the recovery position.	T / F
7	When checking for breathing you should also look for signs of life.	T / F
8	When a person is in cardiac arrest you should check for a pulse every 30 seconds.	T / F
9	You should press down approximately five to six centimetres on the chest when performing chest compressions.	T / F
10	Cardiac arrest is confirmed when a collapsed person is not breathing and there are no signs of life.	T / F
11	In most circumstances the risk of harm to the rescuer whilst resuscitating an individual is high.	T / F
12	On finding a person collapsed you should first check if they have a pulse.	T / F
13	If a person collapses near to you, first check their airway is clear and open.	T / F
14	You should deliver five breaths when you establish the person is not breathing.	T / F
15	Chest compressions are performed at a rate of 60 compressions per minute.	T / F
16	Checking first for possible danger in the environment is an essential part of the assessment process.	T / F
17	If a collapsed person does not respond to you with-in 5 seconds, you should shout for assistance.	T / F
18	If a collapsed person has vomited you should stop resuscitation as they will not survive.	T / F
19	When checking for normal breathing you should take no more than 10 seconds to do so.	T / F
20	You should aim to deliver 100-120 compressions per minute when performing cardio-pulmonary resuscitation.	T / F

Analysis of Pilot Knowledge Assessment

The 1209 BSc (Derby Centre) students kindly completed a pilot knowledge effect during their skills week prior to a refresher session on resuscitation. The group received resuscitation education six months previously, may have been involved in resuscitation events whilst on placement and may have received further resuscitation education external to their nursing course.

Sixty one knowledge assessments were returned from a possible cohort of 76 and four excluded from analysis due to incomplete answers being provided. In an effort to account for the ceiling effect 10, 15 and 20 item knowledge assessments were prepared and students attending resuscitation education asked to complete a paper immediately prior to the session.

Despite the students having received resuscitation education the mean scores for the knowledge assessment were as follows:

Knowledge assessment	Ten item n=21	Fifteen item n=18	Twenty item n=18	First ten items from all papers n=57
Score	6.7/10	9.8/15	14.3/20	7.2/10
Percentage	67%	65%	72%	72%
Range	4-10	6-15	10-20	4-10
All correct	One student	One student	One student	Five students

These results appear to suggest there is little ceiling effect and a ten or fifteen item knowledge assessment should allow sufficient discrimination and evaluate the effectiveness of an intervention.

Alan R. Williams
9 May 2013

Pilot Knowledge Assessment scores

	10 item	15 item	20 item	10 items from all
	n=21	n=18	n=18	n=57
1	4	6	10	
2	4	7	12	
3	4	7	12	
4	5	7	12	
5	6	7	12	
6	6	8	12	
7	6	8	13	
8	6	9	14	
9	6	9	14	
10	7	9	14	
11	7	11	15	
12	7	11	15	
13	7	11	16	
14	7	12	16	
15	8	13	16	
16	8	13	17	
17	8	14	17	
18	8	15	20	
19	8			
20	9			
21	10			
Range	4-10	6-15	10-20	4-10
	141	177	257	411
Mean	6.7/10	9.8/15	14.3/20	
	67%	65%	72%	72%

8.10 RLO Development process

Information for student and tutor participants (student example)

Williams Alan

From:	Williams Alan
Sent:	03 November 2011 08:10
To:	**STUDENT GROUP NAMES**
	Williams Alan; Windle Richard; Wharrad Heather
Cc:	Research project (student group) - Mon 7th November
Subject:	BLS Algorithm.pdf; BLS Guidelines.pdf
Attachments:	

Dear Colleague,

RESEARCH PROJECT – E-LEARNING DEVELOPMENT OF ADULT BLS RESOURCE

Thank you for agreeing to participate in the research on Monday 7th November with your fellow students. I will meet you in the small waiting area beside the B Floor Cafe (near Room B73) in the School of Nursing, QMC, Nottingham on Monday morning. If you could be there shortly before 9am we can all go as a group to the B Floor Learning Laboratory Room and I expect the session to finish by 1pm.

Myself and one or both of my supervisors (Dr Richard Windle and Dr Heather Wharrad) will be present and available during the morning and once some formalities are completed (travel expenses, inconvenience allowance claim, consent forms etc) we will give you a clear indication of how the morning will progress. This will include a brief presentation on resuscitation, web-based learning resources, how you can work as a group and the resources available to you. I enclose some information that you may wish to have a look through before Monday though this will be available on the day in print and electronically. A voucher for mid morning refreshments will be provided.

I look forward to meeting you all and working with you on this research project. If you have any questions please do contact me.

Best wishes

Alan

Alan R. Williams
Lecturer
School of Nursing
(University of Nottingham)
London Road Community Hospital
DERBY
DE1 2QY
DL 01332 724926 (if dialing from University telephone network dial last five digits)
Reception 01332 724949 (as above if dialing from ...)
Skype alan-r-williams-UoN

Review presentation from storyboard (student example)

From: Williams Alan
Sent: 09 January 2012 16:17
To: **STUDENT GROUP NAMES**
Cc: Windle Richard; Wharrad Heather; 'Alan Williams'
Subject: Resuscitation RLO Development - Student group

Dear Student,

Thank you for your participation in my research project and I hope you have received your certificate, expenses and inconvenience allowance safely.

I have created a MS Powerpoint file that I hope starts to reflect how you intended the resource to develop. The use of powerpoint is just a starting point as it is likely software called Articulate (in addition to other media e.g. audio, video, photographs etc.) will be used in the production of the Reusable Learning Object.

I would be very grateful if you would be able to look through the attached file and provide comments on what I have written. I have saved it in a MS Powerpoint 97-03 .ppt so you should be able to open it. Please contact me if you have problems opening the file. You are welcome to make comments on the file or write separately, as you wish. I will collate the results, discuss with my research supervisors and be in contact again. If anyone would like to discuss the work I am happy to make arrangements.

Best wishes and I look forward to hearing from you. My next tutorial with my research supervisors is Tuesday 31st January so any comments gratefully received before then if possible.

Alan

Alan Williams
Lecturer

From: **T5**
Sent: 10 January 2012 13:41
To: Williams Alan
Subject: RE: Resuscitation RLO Development - Tutor group

Hi Alan

I think that is generally a good representation with what was discussed! Good luck with animating the RLO(s)!!

Cheers

T5

From: **T1**
Sent: 10 January 2012 08:57
To: Williams Alan
Subject: RE: Resuscitation RLO Development - Tutor group

Alan

The only comment I have is about the mention of the AED — is this because they are available in the community. If the AED arrives you would need to show the person using it — I thought this was purely BLS and using an AED could be deemed a step further?

Hope your research continues to go

well Regards

T1

From: **S4**
Sent: 13 January 2012 08:51
To: Williams Alan
Subject: RE: Resuscitation RLO Development - Student group

Dear Alan,
Just having a look over the powerpoint and I really like what you've done! Not sure I understand the scenario 2 bit on slide 17 but everything else seems good! I think at the session when we met with the group Dr AB was narrating the whole thing, and that the sceanario was in a public place in Nottingham City Centre. I think the video should be quite short because otherwise people might get bored and loose concentration on the topic, however due to the amount of content we wanted to include, I don't know how short you'll be able to make it!

Best wishes
S4

From: **T2**
Sent: 24 May 2012 07:41
To: Williams Alan
Subject: BLS RLO

Hi Alan

Sorry, I didn't get round to emailing you last night. I think your ideas are fine and can't think of any changes I would make. Good luck with it.

Cheers

T2

Review video (tutor example)

From:	Williams Alan
Sent:	26 November 2012 07:55
To:	**TUTOR GROUP NAMES**
Cc:	Windle Richard; Wharrad Heather
Subject:	Resuscitation Research Project Video

Dear **TUTOR GROUP NAMES**

I now have a final version of the video that you wished incorporated into the Resuscitation RLO and can share this with you - just copy and paste this URL http://www.youtube.com/watch?v=FHQhm1OfBag&feature=youtu.be, into your browser of choice (Internet Explorer, Firefox, Safari etc).

I am afraid it won't be possible to make changes to the film though general comments are welcomed and of course, how the video is incorporated into the e-learning will be part of the development now being completed. This will also be shared with you in due course. You are welcome to view the unlisted video; this means it is only available to whoever I provide the URL link to so just us the link from the email as you shouldn't be able to find it by searching YouTube.

My studies continue with three presentations (METaLs - Nottingham, Articulate - Leeds, Research Seminar - Nottingham) since Spring and another planned, on the phase one research that you participated in. The general reaction has been quite a degree of interest and without your involvement, this would not have been possible. I'll keep you posted on developments are they progress and trust you are all well.

Thanks

Alan

Alan R. Williams
Lecturer
Room 409
School of Nursing, Midwifery & Physiotherapy The University of Nottingham Derby Education Centre Royal Derby Hospital Uttoxeter Road Derby
DE22 3DT
01332 724926
01332 724900
Skype alan-r-williams-uon

From: S4
Sent: 26 November 2012 14:56
To: Williams Alan
Subject: RE: Resuscitation Research Project Video

It looks really good! Good job!
S4

From: T1
Sent: 27 November 2012 13:50
To: Williams Alan
Subject: RE: Resuscitation Research Project Video

Dear Alan

The video looks good. Look forward to seeing the entire RLO

Best wishes

T1

Hi Alan

It looks rather slick!

I think that incorporated everything we suggested, but I am wondering if the mouth to mouth might be criticised!!?

I would be interested to see the video/RLO that the students came up with.....

Many thanks

T5

Student peer reviewers

From: Williams Alan
Sent: 19 July 2013 08:52
To: Hinchcliffe Donna; White Arnie; Underhill Charlotte; Walker Rebecca (10/09); Payne Victoria Subject:
Review of RLO for doctoral studies request

Dear Donna, Arnie, Rebecca, Vicky and Charlotte,

As part of my doctoral studies I have been involved in the creation of two Reusable Learning Objects (RLOs) on resuscitation. One was created by a group of students and one was created by a group of tutors. As both groups are with-in the Division of Nursing I would be grateful if you not share the resource with others, as the student and the tutor group will be reviewing the resource in the near future.

I would be very grateful if you would be able to view both resources and provide comment on the usability of the resources. Keys aspects I am interested in are a) did resource run smoothly b) aspects that did not work well c) were the controls clear. Aspects that probably do require attention are some of the audio though I am sure there are other aspects so please let me know what you think. Do enter data on the external link as this data will be discounted though it is crucial to know if and how it works. Please be frank.

http://www.nottingham.ac.uk~Titznngt/alan/rIo1/player.html - about 13 minutes in total playing time

http://www.nottingham.ac.uk~ntzmgt/alan/rIo2/player.html - about 7 minutes total playing time

Thanks

Alan

Alan R. Williams
Lecturer
Room 409
School of Nursing, Midwifery & Physiotherapy The University of Nottingham Derby Education Centre Royal Derby Hospital Uttoxeter Road Derby
DE22 3DT
01332 724926
01332 724900
Skype alan-r-williams-uon

From:	Underhill Charlotte
Sent:	10 August 2013 21:57
To:	Williams Alan
Subject:	RE: Review of RLO for doctoral studies request

Hi Alan
Sorry its taken me so long to get back to you about these RLO's.
Firstly, they were both brilliant. They both ran smoothly and were really clear and informative.
I liked that in RLO 1 the scenario was played at the start and finish, allowing the viewer to re-cap. I thought that RLO 1 was the better of the two but really liked the quiz aspect from RLO 2 and think this could be incorporated into RLO 1 to improve it.
I think that both would be really useful resources for students :) Hope this helps.
Charlotte

Final RLO for stduent and tutor group to review

From: Williams Alan
Sent: Monday, August 19, 2013 7:26 AM
To: **STUDENT GROUP NAMES**
Subject: Resuscitation RLO Research Project

Dear

You may remember the research project you kindly participated in. in Novemher 2011. There is a link below to the resource that you can review and hope it reflects the work you did. You are welcome to complete the pre and post questions or just view the resources as you wish, as the data collection will he re-set w/c 16 September.

http://www.notting'ham.ac.uk/--ntzmqt/alanklol/player.html - about 13 minutes in total playing time

I would welcome any comments and observations on any aspect of the resource and if possible will incorporate suggestions in a version, to he released the the new intake next month. I would he grateful if you could respond by Mon 9 September 2013.

Best wishes

Alan

Alan R. Williams
Lecturer
Room 409
School of Health Sciences
The University of Nottingham
Derby Education Centre
Royal Derby Hospital
Uttoxeter Road
Derby
DE22 3DT
01332 724926
01332 724900
Skype alan-r-williams-uon

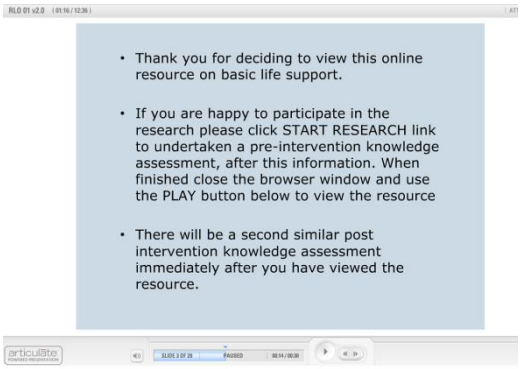
From: **S4**
Sent: 19 August 2013 15:35
To: Williams Alan
Subject: RE: Resuscitation RLO Research Project

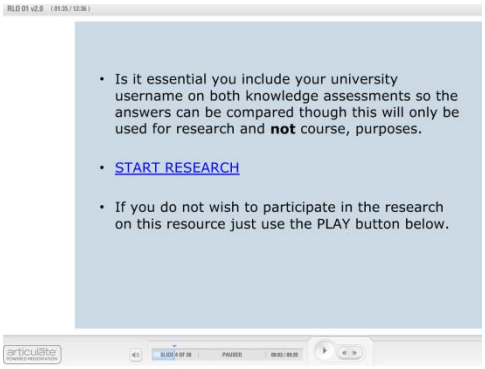
Hi Alan,
I think it the RLO looks great!
Thank you for your email!
Best wishes
S4

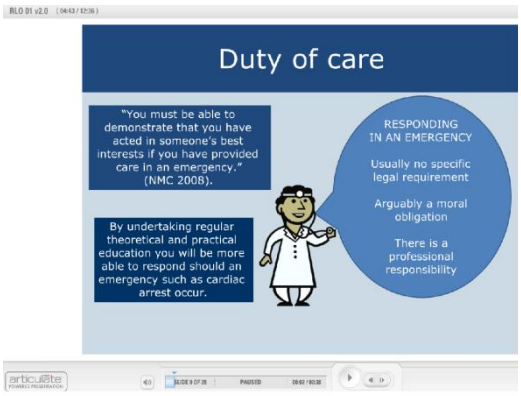
From: **T4**
Sent: 03 September 2013 13:33
To: Williams Alan
Subject: RE: Resuscitation RLO Research Project

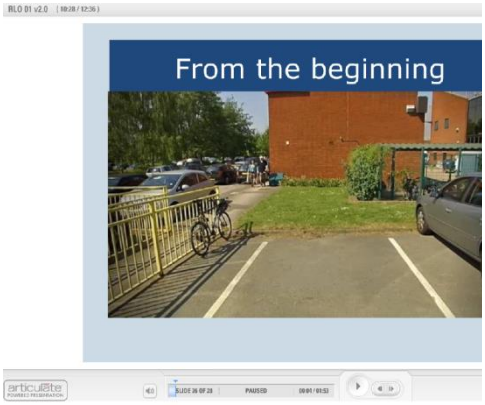
Hi Alan
Well done
I got to chest compressions and could get no further. I know I am a crappy nurse but I couldn't get it to work ! thoughts to this point . There is a change isn voice or volume between some areas of the slides. This may impeed a person with compromised hearing.
I lost the link from breathing to chest compressions. Obviously I then got stuck any advise?
nicky
T4

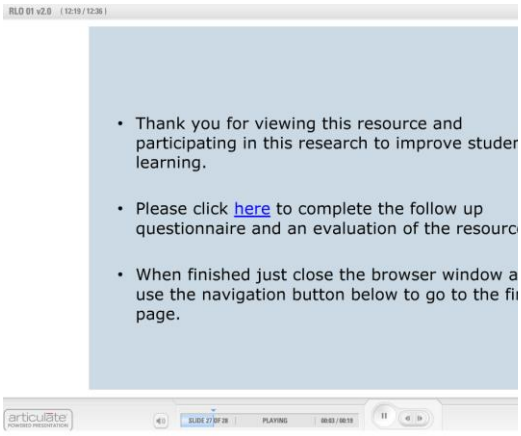
Selected screenshots from student generated RLO (RLO 01)



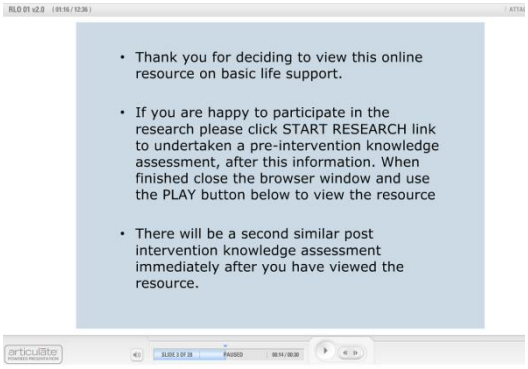


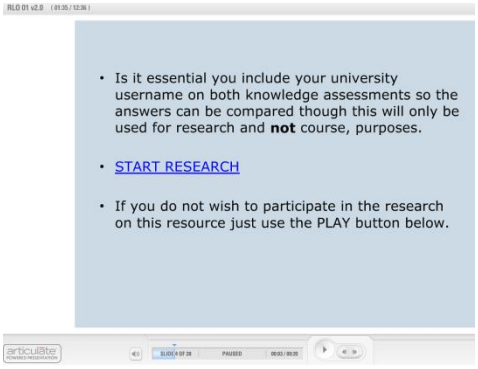


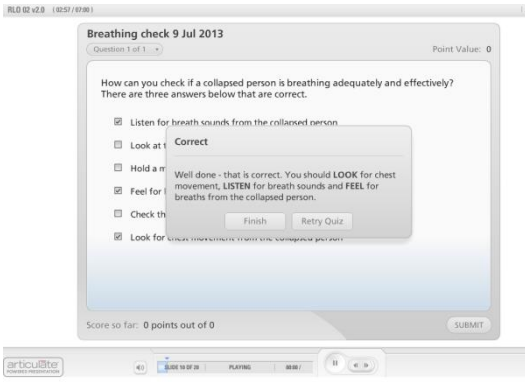


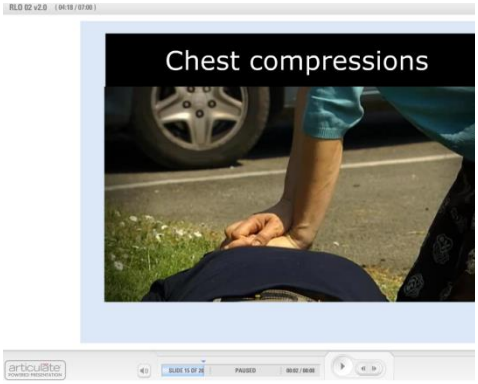


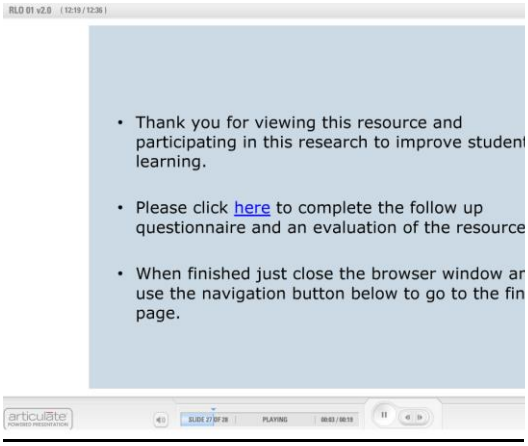
Selected screen shots of student generated RLO (RLO 01)

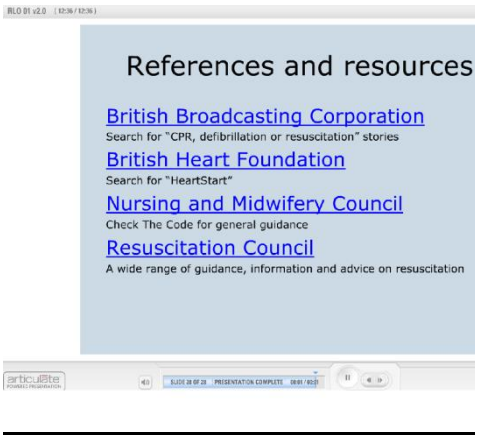












8.11 Tuckman Group Stages used with Observer XT10

Not defined	Forming	Storming	Norming	Performing
i	**r**	**g**	**c**	**h**
unsure to be reviewed	orientation/ testing/ dependence questions, seeking opinions testing the water	conflict clear disagreement, discomfort with-in the group	group cohesion clear agreement with- in group as to progress	functional role relatedness solutions/options suggested and general agreement as viable

8.12 LOAM Tool Pedagogical Factors for Observer XT10

NB All discussion is considered to be group discussion. This will be determined by the researcher making a judgement on what the particular behaviour the section of discussion is about, following the Windle et al 2007 framework (interactivity, objective, etc.)

not defined d

ACTIVITY				ENVIRONMENT				ROLES			
1 Alignment	2 Assessment	3 Navigation	4 Interactivity	5 Media richness	6 Context	7 Integration	8 Objective	9 Self-direction	10 Feedback	11 Support	12 Pre-requisites
a	**s**	**n**	**t**	**m**	**b**	**e**	**o**	**l**	**f**	**u**	**p**
Discussion about the assessment being related to the learning goal (objective). Will include modifiers here with assessments **relevant** and **not relevant** to the learning goal.	Discussion whether there should be assessment(s) included in the RLO.	Discussion about the detail of the control the user has over the RLO (stopping, starting, rewinding, reviewing a section for example).	Discussion about more than passively watching RLO, such as using controls to interact with RLO (though not assessment as separate category). Example could be including a drag and drop exercise, clicking on a picture; essentially any interaction with an RLO by the user that is not part of an assessment.	Discussion about the media quality suggested being included in the RLO. The actual quality of the media actually used is out with this analysis; it is the consideration of this factor by both, one or neither of the groups that will be investigated.	Discussion if RLO could be used by other health or non-health learners of basic adult resuscitation.	Discussion about the inclusion of types of media (audio, photo, animation, video, images) to be included in storyboard.	Discussion about content of RLO related to its objective (in this case 1st year st/n learning BLS knowledge), with modifiers of **relevant discussion** as default position and **irrelevant discussion** as option when discussion not relevant to objective (i.e. Adult BLS Algorithm and junior/first year student nurses)	Discussion whether the user is able to control the progression of the RLO or if no control by the user should be allowed.	Discussion as to the feedback provided to the user during the RLO. This could be an audible alert, a timer, a message on the screen that provides information to the user about their progress including progression throughout the RLO.	Discussion as to the level of support built in for the user of the RLO. How much assistance the user of the RLO can obtain from help buttons or instructions as they use the RLO.	Discussion whether prior knowledge required before using RLO. Examples could be consideration what background the users will be from and this is pre use knowledge necessary to use the RLO, whether any preparation is required prior to using the RLO.

8.13 Tuckman and LOAM Reliability Measures

Student – Group Stage (Tuckman)
Video Clip 1 00:24:19-00:29:19 (1459-1759 seconds on Observer software file)

INSTRUCTIONS

Please view this short video clip 1 and mark (electronically or on paper) on the grid above at what stage you feel the group is at on the Tuckman model –see below for description.

What A quality control measure to assess the reliability of observations made by a researcher viewing the same video

How By viewing the 5 minute video clip and marking on the above grid whether you think the group is **forming**, **storming**, **norming** or **performing**. You can shade in the relevant box or just tick, though there must only be one mark in each vertical box as the group can't be forming **and** storming at the same time. Use your judgement, against the descriptions below to make a decision.

Why As a reliability measure to cross reference with another assessor of the group functioning to validate observations made.

When Ideally by the third week in July 2015.

Where Where ever you have access to a computer or tablet to view the video. Note, there is audio as well and you will need speakers or headphones to make your observation.

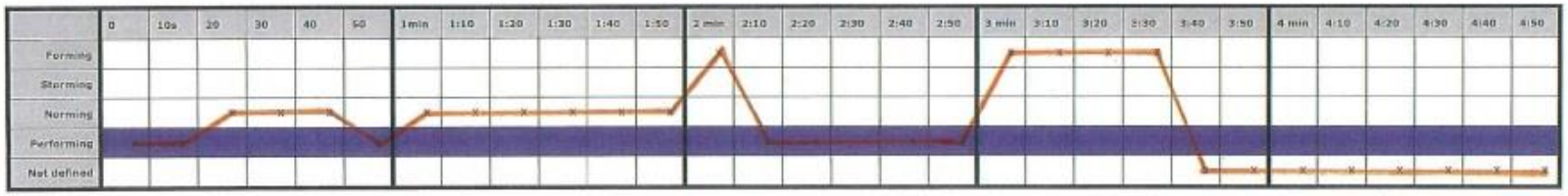
Tuckman Group Stages development (Tuckman 1965)

Forming	Storming	Norming	Performing	Not defined
orientation/ testing/ dependence	conflict	group cohesion	functional role-relatedness	unsure to be reviewed
questions, seeking opinions testing the water	clear disagreement, discomfort with-in the group	clear agreement with-in group as to progress	solutions/options suggested and general agreement as viable	

Bruce Tuckman is a psychologist who investigated and proposed a theory of how groups develop, from reviewing published literature describing therapy, training and experimental group. He coined the phrases **Forming**, **Storming**, **Norming** and **Performing** and partially ascribes the popularity of his model to these accessible terms. With a colleague a decade later they added **Ajourning** though the four category model retains popularity to this day, particularly in the business field.

Tuckman, B. (1965) Developmental sequences in small groups. **Psychological Bulletin.** 63(6):pp.384-399.

Student – Group Stage (Tuckman)
Video Clip 2 01:12:47-01:17:47 (4377 – 4677 seconds on Observer software file)



INSTRUCTIONS

Please view this short video clip 1 and mark (electronically or on paper) on the grid above at what stage you feel the group is at on the Tuckman model –see below for description.

What A quality control measure to assess the reliability of observations made by a researcher viewing the same video

How By viewing the 5 minute video clip and marking on the above grid whether you think the group is **forming, storming, norming** or **performing**. You can shade in the relevant box or just tick, though there must only be one mark in each vertical box as the group can't be forming **and** storming at the same time. Use your judgement, against the descriptions below to make a decision.

Why As a reliability measure to cross reference with another assessor of the group functioning to validate observations made.

When Ideally by the third week in July 2015.

Where Where ever you have access to a computer or tablet to view the video. Note, there is audio as well and you will need speakers or headphones to make your observation.

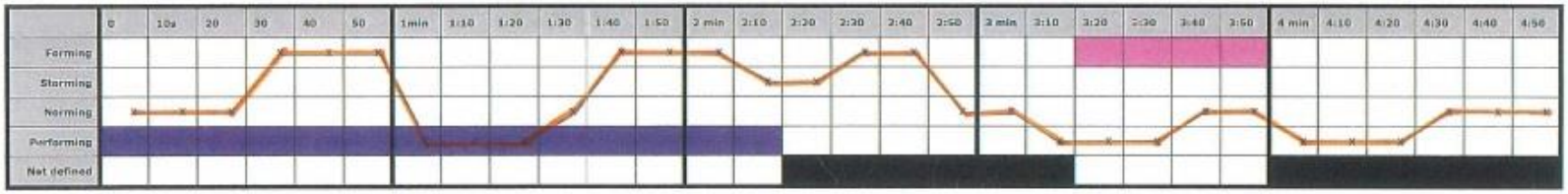
Tuckman Group Stages development (Tuckman 1965)

Forming	Storming	Norming	Performing	Not defined
orientation/ testing/ dependence	conflict	group cohesion	functional role-relatedness	unsure to be reviewed
questions, seeking opinions testing the water	clear disagreement, discomfort with-in the group	clear agreement with-in group as to progress	solutions/options suggested and general agreement as viable	

Bruce Tuckman is a psychologist who investigated and proposed a theory of how groups develop, from reviewing published literature describing therapy, training and experimental group. He coined the phrases **Forming**, **Storming**, **Norming** and **Performing** and partially ascribes the popularity of his model to these accessible terms. With a colleague a decade later they added **Ajourning** though the four category model retains popularity to this day, particularly in the business field.

Tuckman, B. (1965) Developmental sequences in small groups. **Psychological Bulletin.** 63(6):pp.384-399.

Tutor – Group Stage (Tuckman)
Video Clip 1 00:27:40-00:32:40 (1660-1960 seconds on Observer software file)



INSTRUCTIONS

Please view this short video clip 1 and mark (electronically or on paper) on the grid above at what stage you feel the group is at on the Tuckman model –see below for description.

What A quality control measure to assess the reliability of observations made by a researcher viewing the same video

How By viewing the 5 minute video clip and marking on the above grid whether you think the group is **forming, storming, norming** or **performing**. You can shade in the relevant box or just tick, though there must only be one mark in each vertical box as the group can't be forming **and** storming at the same time. Use your judgement, against the descriptions below to make a decision.

Why As a reliability measure to cross reference with another assessor of the group functioning to validate observations made.

When Ideally by the third week in July 2015.

Where Where ever you have access to a computer or tablet to view the video. Note, there is audio as well and you will need speakers or headphones to make your observation.

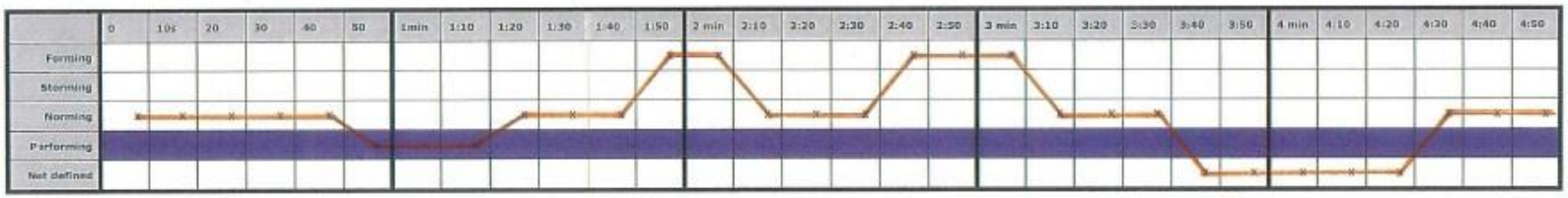
Tuckman Group Stages development (Tuckman 1965)

Forming	Storming	Norming	Performing	Not defined
orientation/ testing/ dependence	conflict	group cohesion	functional role-relatedness	unsure to be reviewed
questions, seeking opinions testing the water	clear disagreement, discomfort with-in the group	clear agreement with-in group as to progress	solutions/options suggested and general agreement as viable	

Bruce Tuckman is a psychologist who investigated and proposed a theory of how groups develop, from reviewing published literature describing therapy, training and experimental group. He coined the phrases **Forming, Storming, Norming** and **Performing** and partially ascribes the popularity of his model to these accessible terms. With a colleague a decade later they added **Ajourning** though the four category model retains popularity to this day, particularly in the business field.

Tuckman, B. (1965) Developmental sequences in small groups. **Psychological Bulletin.** 63(6):pp.384-399.

Tutor – Group Stage (Tuckman)
Video Clip 2 01:23:00-01:28:00 (4980-5280 seconds on Observer software file]



INSTRUCTIONS

Please view this short video clip 1 and mark (electronically or on paper) on the grid above at what stage you feel the group is at on the Tuckman model –see below for description.

What A quality control measure to assess the reliability of observations made by a researcher viewing the same video

How By viewing the 5 minute video clip and marking on the above grid whether you think the group is **forming, storming, norming** or **performing**. You can shade in the relevant box or just tick, though there must only be one mark in each vertical box as the group can't be forming **and** storming at the same time. Use your judgement, against the descriptions below to make a decision.

Why As a reliability measure to cross reference with another assessor of the group functioning to validate observations made.

When Ideally by the third week in July 2015.

Where Where ever you have access to a computer or tablet to view the video. Note, there is audio as well and you will need speakers or headphones to make your observation.

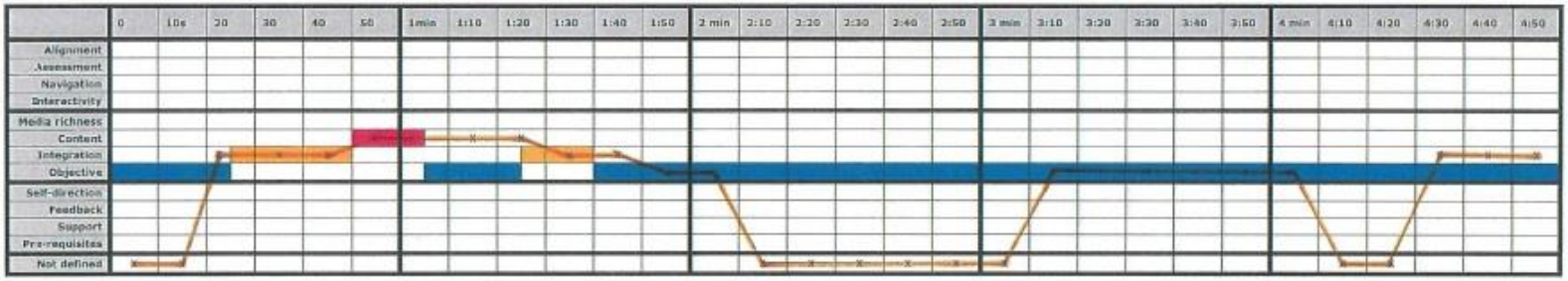
Tuckman Group Stages development (Tuckman 1965)

Forming	Storming	Norming	Performing	Not defined
orientation/ testing/ cependence	conflict	group cohesion	functional role-relatedness	unsure to be reviewed
questions, seeking opinions testing the water	clear disagreement, discomfort with-in the group	clear agreement with-in group as to progress	solutions/options suggested and general agreement as viable	

Bruce Tuckman is a psychologist who investigated and proposed a theory of how groups develop, from reviewing published literature describing therapy, training and experimental group. He coined the phrases **Forming, Storming, Norming** and **Performing** and partially ascribes the popularity of his model to these accessible terms. With a colleague a decade later they added **Ajourning** though the four category model retains popularity to this day, particularly in the business field.

Tuckman, B. (1965) Developmental sequences in small groups. **Psychological Bulletin.** 63(6):pp.384-399.

Student – Group Discussion (LOAM Tool)
Video Clip 1 00:24:19-00:29:19 (1459-1759 seconds on Observer software file)



INSTRUCTIONS

Please view this short video clip 1 and mark (electronically or on paper) on the grid above at what stage you feel the group is at on the LOAM model –see below for description.

What — A quality control measure to assess the reliability of observations made by a researcher viewing the same video

How — By viewing the 5 minute video clip and marking on the above grid whether you think the group is discussing **Alignment** or **Assessment** or the **Objective** etc. You can shade in the relevant box or just tick, though there must only be one mark in each vertical box as the group can't be discussing **Alignment** and **Assessment** at the same time. Use your judgement, against the descriptions below to make a decision.

Why — As a reliability measure to cross reference with another assessor of the group functioning to validate observations made.

When — Ideally by the third week in July 2015.

Where — Where ever you have access to a computer or tablet to view the video. Note, there is audio as well and you will need speakers or headphones to make your observation.

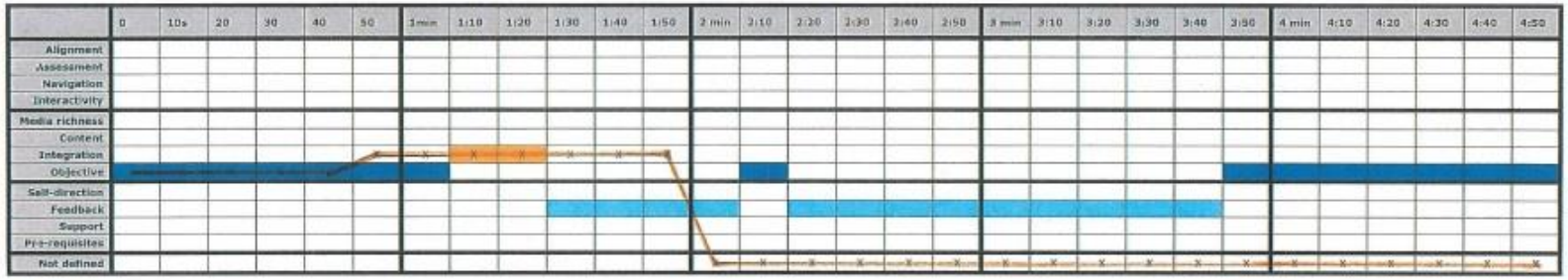
Group discussion classification for use with Observer XT 10 – (Windle, Wharrad, Leeder and Morales, 2007)

NB All discussion is considered to be group discussion. This will be determined by the researcher making a judgement on what the particular behaviour the section of discussion is about, following the Windle et al 2007 framework (interactivity, objective, etc.)

ACTIVITY				ENVIRONMENT				ROLES			
1 Alignment	2 Assessment	3 Navigation	4 Interactivity	5 Media richness	6 Context	7 Integration	8 Objective	9 Self direction	10 Feedback	11 Support	12 Pre-requisites
Discussion about the assessment being related to the learning goal - objective). Will include modifiers here with assessments **relevant** and **not relevant** to the learning goal.	Discussion whether there should be assessment(s) included in the RLO.	Discussion about the detail of the control the user has over the RLO (stopping, starting, rewinding, reviewing a section for example)	Discussion about more than passively watching RLO, such as using controls to interact with RLO (though not assessment as separate category). Example could be including a drag and drop exercise, clicking on a picture; essentially any interaction with an RLO by the user that is not part of an assessment	Discussion about the **media quality** suggested being included in the RLO. The actual quality of the media actually used is out with this analysis; it is the consideration of this factor by both, one or neither of the groups that will be investigated.	Discussion if RLO could be used by other health or non-health learners of basic adult resuscitation.	Discussion about the inclusion of types of media (audio, photo, animation, video, images) to be included in storyboard.	Discussion about content of RLO related to its objective (in this case 1st year st/n learning BLS knowledge), with **modifiers of relevant discussion** as default position and **irrevelant discussion** as option when discussion not relevant to objective (i.e. Adult BLS Algorithm and junior/first year student nurses)	Discussion whether the user is able to control the progression of the RLO or if is control by the user should be a lower.	Discussion as to the feedback provided to the user during the RLO. This could be an audible alert, a timer, a message on the screen that provides information to the user about their progress including progression throughout the RLO.	Discussion as to the level of support built in for the user of the RLO. How much assistance the user of the RLO can obtain from help buttons or instructions as they use the RLO.	Discussion whether prior knowledge required before using RLO. Examples could be consideration what background the users will be from and this is pre use knowledge necessary to use the RLO, whether any preparation is required prior to using the RLO

Windle, R., Wharrad, H., Leeder, D. and Morales, R. (2007) Analysis of the pedagogical attributes of learning objects [online]. Available at: http://www.nottingham.ac.uk/nursing/sonet/projects/loam/load/docs/edmedia-final.pdf [Accessed 26 May 2015.]

Student – Group Discussion (LOAM Tool)
Video Clip 2 01:12:47-01:17:47 (4377 – 4677 seconds on Observer software file)



INSTRUCTIONS

Please view this short video clip 1 and mark (electronically or on paper) on the grid above at what stage you feel the group is at on the LOAM model –see below for description.

What — A quality control measure to assess the reliability of observations made by a researcher viewing the same video

How — By viewing the 5 minute video clip and marking on the above grid whether you think the group is discussing **Alignment** or **Assessment** or the **Objective** etc. You can shade in the relevant box or just tick, though there must only be one mark in each vertical box as the group can't be discussing **Alignment** and **Assessment** at the same time. Use your judgement, against the descriptions below to make a decision.

Why — As a reliability measure to cross reference with another assessor of the group functioning to validate observations made.

When — Ideally by the third week in July 2015.

Where — Where ever you have access to a computer or tablet to view the video. Note, there is audio as well and you will need speakers or headphones to make your observation.

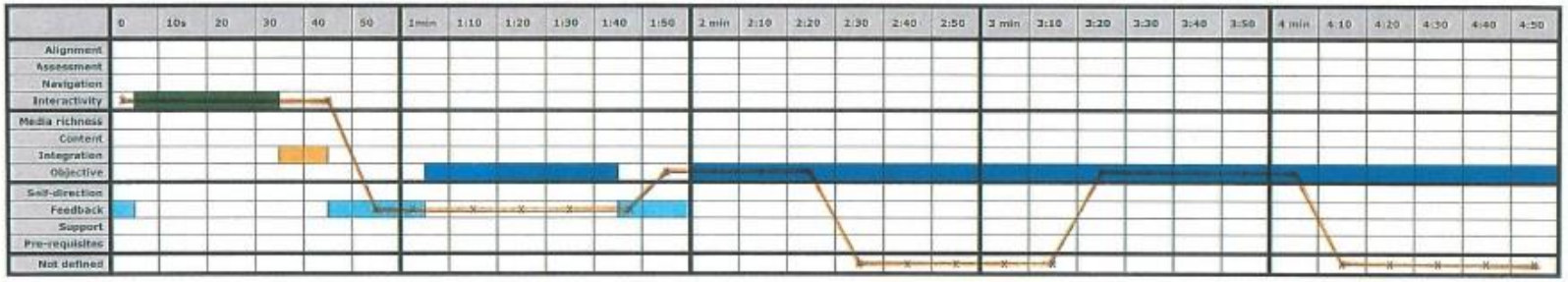
Group discussion classification for use with Observer XT 10 – (Windle, Wharrad, Leeder and Morales, 2007)

NB All discussion is considered to be group discussion. This will be determined by the researcher making a judgement on what the particular behaviour the section of discussion is about, following the Windle et al 2007 framework (interactivity, objective, etc.)

ACTIVITY				ENVIRONMENT				ROLES			
1 Alignment	2 Assessment	3 Navigation	4 Interactivity	5 Media richness	6 Context	7 Integration	8 Objective	9 Self-direction	10 Feedback	11 Support	12 Pre-requisites
Discussion about the **assessment** being related to the learning goal (objective). Will include modifiers here with assessments **relevant** and **not relevant** to the learning goal.	Discussion whether there should be assessment(s) included in the RLO.	Discussion about the detail of the control the user has over the RLO (stopping, starting, rewinding, reviewing a section for example).	Discussion about more than passively watching RLO, such as using controls to interact with RLO (though not assessment as separate category). Example could be including a drag and drop exercise, clicking on a picture; essentially any interaction with an RLO by the user that is not part of an assessment.	Discussion about the media quality suggested being included in the RLO. The **actual** quality of the media actually used is out with this analysis; it is the consideration of this factor by both, one or neither of the groups that will be investigated.	Discussion if RLO could be used by other health or non-health learners of basic adult resuscitation.	Discussion about the inclusion of types of media (audio, photo, animation, video, images) to be included in storyboard.	Discussion about content of RLO related to its objective (in this case 1st year st/n learning BLS knowledge), with modifiers of **relevant discussion** as default position and **irrevelant discussion** as option when discussion not relevant to objective (i.e. Adult BLS Algorithm and junior/first year student nurses)	Discussion whether the user is able to control the progression of the RLO or if it should be the user should be allowed.	Discussion as to the feedback provided to the user during the RLO. This could be an audible alert, a timer, a message on the screen that provides information to the user about their progress including progression throughout the RLO.	Discussion as to the level of support built in for the user of the RLO. How much assistance the user of the RLO can obtain from help buttons or instructions as they use the RLO.	Discussion whether prior knowledge required before using RLO. Examples could be consideration what background the users will be from and this is pre use knowledge necessary to use the RLO, whether any preparation is required prior to using the RLO.

Windle, R., Wharrad, H., Leeder, D. and Morales, R. (2007) Analysis of the pedagogical attributes of learning objects [online]. Available at: http://www.nottingham.ac.uk/nursing/sonet/projects/loam/load/docs/edmedia-final.pdf [Accessed 26 May 2015.]

Tutor – Group Discussion (LOAM Tool)
Video Clip 1 00:27:40-00:32:40 (1660-1960 seconds on Observer software file)



INSTRUCTIONS

Please view this short video clip 1 and mark (electronically or on paper) on the grid above at what stage you feel the group is at on the LOAM model –see below for description.

What — A quality control measure to assess the reliability of observations made by a researcher viewing the same video

How — By viewing the 5 minute video clip and marking on the above grid whether you think the group is discussing **Alignment** or **Assessment** or the **Objective** etc. You can shade in the relevant box or just tick, though there must only be one mark in each vertical box as the group can't be discussing **Alignment** and **Assessment** at the same time. Use your judgement, against the descriptions below to make a decision.

Why — As a reliability measure to cross reference with another assessor of the group functioning to validate observations made.

When — Ideally by the third week in July 2015.

Where — Where ever you have access to a computer or tablet to view the video. Note, there is audio as well and you will need speakers or headphones to make your observation.

Group discussion classification for use with Observer XT 10 – (Windle, Wharrad, Leeder and Morales, 2007)

NB All discussion is considered to be group discussion. This will be determined by the researcher making a judgement on what the particular behaviour the section of discussion is about, following the Windle et al 2007 framework (interactivity, objective, etc.)

ACTIVITY				ENVIRONMENT				ROLES			
1 Alignment	2 Assessment	3 Navigation	4 Interactivity	5 Media richness	6 Context	7 Integration	8 Objective	9 Self direction	10 Feedback	11 Support	12 Pre-requisites
Discussion about the assessment being related to the learning goal (objective). Will include modifiers here with assessments **relevant** and **not relevant** to the learning goal.	Discussion whether there should be assessment(s) included in the RLO.	Discussion about the detail of the control the user has over the RLO (stopping, starting, rewinding, reviewing a section for example).	Discussion about more than passively watching RLO, such as using controls to interact with RLO (though not assessment as separate category). Example could be including a drag and drop exercise, clicking on a picture; essentially any interaction with an RLO by the user that is not part of an assessment.	Discussion about the media quality suggested being included in the RLO. The actual quality of the media actually used is out with this analysis; it is the consideration of this factor by both, one or neither of the groups that will be investigated.	Discussion if RLO could be used by other health or non-health learners of basic adult resuscitation.	Discussion about the inclusion of types of media (audio, photo, animation, video, images) to be included in storyboard.	Discussion about content of RLO related to its objective (in this case 1st year st/n learning BLS knowledge), with modifiers of **relevant discussion** as default position and **irrevelant discussion** as option when discussion not relevant to objective (i.e. Adult BLS Algorithm and junior/first year student nurses)	Discussion whether the user is able to control the progression of the RLO or if no control is the user should be allowed.	Discussion as to the feedback provided to the user during the RLO. This could be an audible alert, a timer, a message on the screen that provides information to the user about their progress including progression through the RLO.	Discussion as to the level of support built in for the user of the RLO. How much assistance the user of the RLO can obtain from help buttons or instructions as they use the RLO.	Discussion whether prior knowledge required before using RLO. Examples could be consideration what background the users will be from and the level and knowledge necessary to use the RLO, whether any preparation is required prior to using the RLO.

Windle, R., Wharrad, H., Leeder, D. and Morales, R. (2007) Analysis of the pedagogical attributes of learning objects [online]. Available at: http://www.nottingham.ac.uk/nursing/sonet/projects/loam/load/docs/edmedia-final.pdf [Accessed 26 May 2015.]

Tutor – Group Discussion (LOAM Tool)
Video Clip 2 01:23:00-01:28:00 (4980-5280 seconds on Observer software file)

INSTRUCTIONS

Please view this short video clip 1 and mark (electronically or on paper) on the grid above at what stage you feel the group is at on the LOAM model –see below for description.

What — A quality control measure to assess the reliability of observations made by a researcher viewing the same video

How — By viewing the 5 minute video clip and marking on the above grid whether you think the group is discussing **Alignment** or **Assessment** or the **Objective** etc. You can shade in the relevant box or just tick, though there must only be one mark in each vertical box as the group can't be discussing **Alignment** and **Assessment** at the same time. Use your judgement, against the descriptions below to make a decision.

Why — As a reliability measure to cross reference with another assessor of the group functioning to validate observations made.

When — Ideally by the third week in July 2015.

Where — Where ever you have access to a computer or tablet to view the video. Note, there is audio as well and you will need speakers or headphones to make your observation.

Group discussion classification for use with Observer XT 10 – (Windle, Wharrad, Leeder and Morales, 2007)

NB All discussion is considered to be group discussion. This will be determined by the researcher making a judgement on what the particular behaviour the section of discussion is about, following the Windle et al 2007 framework (interactivity, objective, etc.)

ACTIVITY				ENVIRONMENT				ROLES			
1 Alignment	2 Assessment	3 Navigation	4 Interactivity	5 Media richness	6 Context	7 Integration	8 Objective	9 Self-direction	10 Feedback	11 Support	12 Pre-requisites
Discussion about the assessment being related to the learning goal (objective). Will include modifiers here with assessments **relevant** and **not relevant** to the learning goal.	Discussion whether there should be assessment(s) included in the RLO.	Discussion about the detail of the control the user has over the RLO (stopping, starting, rewinding, reviewing a section for example)	Discussion about more than passively watching RLO, such as using controls to interact with RLO (though not assessment as separate category). Example could be including a drag and drop exercise, clicking on a picture; essentially any interaction with an RLO by the user that is not part of an assessment.	Discussion about the media quality suggested being included in the RLO. The actual quality of the media actually used is out with this analysis; it is the consideration of this factor by both, one or neither of the groups that will be investigated.	Discussion if RLO could be used by other health or non-health learners of basic adult resuscitation.	Discussion about the inclusion of types of media (audio, photo, animation, video, images) to be included in storyboard.	Discussion about content of RLO related to its objective (in this case 1st year st/n learning BLS knowledge), with modifiers of **relevant discussion** as default position and **irrevelant discussion** as option when discussion not relevant to objective (i.e. Adult BLS Algorithm and junior/first year student nurses)	Discussion whether the user is able to control the progression of the RLO or if progress by the user should be allowed.	Discussion as to the feedback provided to the user during the RLO. This could be an audible alert, a timer, a message on the screen that provides information to the user about their progress including progression throughout the RLO.	Discussion as to the level of support built in for the user of the RLO, how much assistance the user of the RLO can obtain from help buttons or instructions as they use the RLO.	Discussion whether prior knowledge required before using RLO. Examples could be consideration what background the users will be from and the level of pre use knowledge necessary to use the RLO, whether any preparation is required prior to using the RLO.

Windle, R., Wharrad, H., Leeder, D. and Morales, R. (2007) Analysis of the pedagogical attributes of learning objects [online]. Available at: http://www.nottingham.ac.uk/nursing/sonet/projects/loam/load/docs/edmedia-final.pdf [Accessed 26 May 2015.]

8.14 Agile Development Method Storyboard Workshop guide.

The design of a learning object should follow an accepted methodology, as described overleaf. An awareness by designers of Tuckman's stages of group development (Tuckman, 1965) and the LOAM Tool Pedagogical Factors (Windle, Wharrad, Leeder & Morales, 2007) theories should facilitate a more effective storyboard creation workshop when a group of designers are working together.

Tuckman's stages of group development model theory

KEY	Forming	Storming	Norming	Performing
Tuckman's descriptions (Tuckman, 1965)	orientation, testing and dependence	resistance to group influences and task requirement	openness to other group members	constructive action
Interpretation of each stage	questions, seeking opinions testing the water	clear disagreement, discomfort with-in the group	clear agreement with-in group as to progress	solutions and options suggested and general agreement as viable

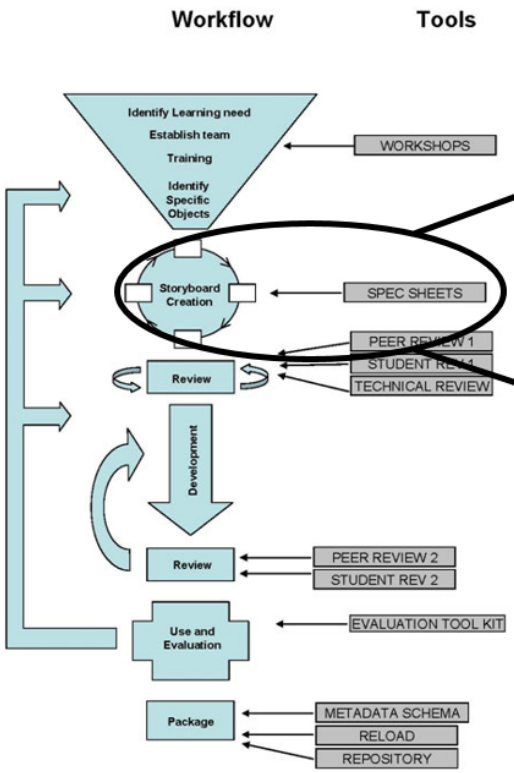
Bruce Tuckman identified groups have four distinct stages and whilst it is not known what the optimum time or how groups should progress through each stage, it would be logical for them to spend most time **performing**. The **forming** stage is unavoidable and it may be some degree of **storming** is healthy though if this become disruptive then need to be addressed so the group can progress onto **norming** and ultimately **performing**.

LOAM Tool pedagogical factors theory

ACTIVITY	ENVIRONMENT	ROLES
Alignment How well any assessment covers aspects pf the learning goal.	**Media-richness** A determination of the quality of included media.	**Self-direction** How much choice the learner has when using the RLO.
Assessment To what extent an assessment was included.	**Context** How congruent the learning was with the background.	**Feedback** The level and degree to which feedback responds to the learner's needs.
Navigation How the user could navigate around the RLO and how much control the user has.	**Integration** The extent to which different types and quality of media are included.	**Support** The level of support or instruction available to the learner.
Interactivity The degree to which the design of the RLO allows the user to interact with the resource.	**Objective** How well the content reflects the objective of the resource.	**Pre-requisites** The degree of prior knowledge required to effectively use the RLO.

Windle and colleagues identified what pedagogical factors could be represented in a learning object, basing their classification on IMS Learning Design principles (IMS Global Learning Consortium, 2003). Three main components of a learning object may be considered analogous to a play where **Activities** are performed, in a particular **Environment** where the learner has particular **Roles** to play. An awareness of these pedagogical factors in the design process should allow the final learning object produced to incorporate pedagogy as well as a technology in the design.

Agile Development Method Storyboard Workshop guide (continued)



Theory Led Storyboard Workshop

When a storyboard creation workshop is planned for the design of a learning object on established knowledge, designers should be made aware of Tuckman's group development theory and what pedagogical factors appear important in the design of the resource.

Tuckman's stages of group development model (forming, storming, norming and performing) provides an accessible framework facilitators can apply during a storyboard creation workshop. By making project facilitators and learning object designers aware of Tuckman's model it will be possible to identify if group dynamics may be interfering in the design process allowing the facilitators to intervene and achieve a more effective workshop.

An awareness of the twelve pedagogical factors of the LOAM Tool will allow learning object designers to focus their discussion on factors that may enhance the effectiveness of a resource. From this research project it appears project facilitators may need to ensure the objective of a workshop is clear to designers and that how the learner will navigate a resource is important.