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**Team Deliberate Practice in Nursing  
Undergraduate Simulation-based Education.**

Alan Thomas Platt

EdD

2019

# **Team Deliberate Practice in Nursing Undergraduate Simulation-based Education.**

Alan Thomas Platt

A thesis submitted in partial fulfilment of the  
requirements of the University of Northumbria at  
Newcastle for the degree of Professional Doctorate  
Research undertaken in the Faculty of Health and Life  
Sciences

September 2019



# Abstract

The use of simulation-based education as a learning and teaching methodology has grown in prominence over the past decade in the education and training of healthcare professionals. Despite this and, a growing evidence base for its use, a wide variation in the quality of its provision has been reported. In addition, this methodology, due to the resource intensive nature of its delivery, has significant costs attached to it, which has led to increasing calls to justify its continued use. As a result, simulation-based education should be underpinned by high quality pedagogic research that was aimed at identifying the instructional design features that both augmented its delivery and enriched participant learning.

This thesis was undertaken to develop a new simulation-based education approach that would enhance the learning of student nurses within the finite institutional resources available. A literature review identified that the deliberate practice framework and, in particular, team deliberate practice, offered a possible solution to this problem. This led me to develop the Simulation using Team Deliberate Practice model. A unique and innovative model that combined both simulation-based education standards with the deliberate practice framework. This offered participants the opportunity to work towards a set of well-defined goals, rehearse their skills in a highly structured model that empowered them to review and reflect on their performance whilst receiving expert guidance and feedback.

Using a longitudinal quasi-experimental design, the effects of the Simulation using Team Deliberate Practice model, compared to those of the traditional simulation-based education

method, on the performance, knowledge and self-efficacy of second year adult nursing students. Performance was measured at a sub-group level using the participants established study groups (N=4), which were randomised into either the intervention (N=2) or comparison (N=2) arms of the study. These were further divided into four sub-groups each giving sixteen sub-groups in total (Intervention arm n=8 and comparison arm n=8). The knowledge and self-efficacy of the participants (N=93) was measured at an individual level.

Data was analysed using a range of statistical techniques. The findings from the mixed ANOVA analysis inferred that the use of the Simulation using Team Deliberate Practice model led to a statistically significant improvement, over time, in the performance of participants ( $F_{(1, 6)} = 19.12, p = .005$ ), a key feature of deliberate practice. Statistically significant improvements in the interventions arms performance scores ( $t_{(7)} = -7.02, p = <.001$ ) and reduction in their time on task ( $t_{(14)} = 5.12, p = <.001$ ) in phase one were also found. Thus inferring an association between the Simulation using Team Deliberate Practice model and the enhanced performance of the participants in the intervention groups, which enabled them to achieve greater levels of performance over the same time period as those undertaking traditional simulation-based education. There were no statistically significant effects found on the knowledge and self-efficacy of the participants.

The study concluded that using the Simulation using Team Deliberate Practice model was a viable approach to use within adult nursing pre-registration education as it could potentially optimise participant's performance whilst maximising the delivery of simulation-based education in the resources available. As professional nursing regulators and educational institutes explore replacing clinical practice with simulation this potentially would be of interest to simulation based educators in nursing. This approach could also be easily

integrated into an existing programme and, as such, could positively impact on the delivery of simulation-based education in the area of pre-registration adult nursing.

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# Declaration

I declare that the work contained in this thesis has not been submitted for any other award and that it is all my own work. I also confirm that this work fully acknowledges opinions, ideas and contributions from the work of others.

Any ethical clearance for the research presented in this thesis has been approved. Approval has been sought and granted by the Faculty Ethics Committee / University Ethics Committee / on [date].

I declare that the Word Count of this Thesis is 74,191 words.

Name: Alan Thomas Platt

Signature:

Date: 04/03/2018

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Finally, to my family for their support and understanding, which has been colossal and unwavering. Amanda you are a rock and, as always, I could not have undertaken this



journey without you, you are my guiding light. Thank you to the kids, Thomas, Rosie and Millie, for putting up with me and, my many absences whilst I was doing my homework, you are amazing, truly inspirational.

# Glossary and abbreviations

Additivity	When there are several predictor variables this refers to the additive nature of their combined effects (Field, 2013, p. 167).
Alpha ( $\alpha$ ) level	The probability of making a type 1 error (Usually set at .05) (Field, 2013, p. 870).
ASPiH	The Association for Simulated Practice in Healthcare
Assumptions	Characteristics of the data that are presumed to be true and a violation of these can invalidate the results (Polit, 2010a, p. 397).
Autocorrelation	When the residuals of two observations in a regression model are correlated (Field, 2013, p. 311).
Beta ( $\beta$ ) coefficient	A standardised coefficient in multiple regression analysis that indicates the relative weight of a predictor variable and this represents the slope of the regression line (Plichta et al., 2013, p. 342; Polit, 2010a, p. 397; Tolmie et al., 2011, p. 102).
Beta ( $\beta$ ) level	The probability of making a type II error (usually set at 0.2) (Cohen, 1988, p. 14; Field, 2013, p. 870).
Bias	An influence that distorts the results and undermines study validity (Polit, 2010a, p. 397).
Bootstrap method	This method estimates the properties of the sampling distribution from the sample data by taking samples of the scores from the study population and randomly repeating these between 1000 and 2000 times (Field, 2013, p. 199).

Coaching	To direct or instruct a person or group of people in order to achieve goals, develop specific skills, or develop competencies (Lopreiato et al., 2016).
Cohen's <i>d</i>	A common statistical test used to calculate effect size (Hojat and Xu, 2004), and is calculated by dividing the mean of the two groups by their pooled standard deviations (Adamson and Prion, 2013a).
Correlation	A bond between variables where the variation in one variable is related to variation in the other (Polit, 2010a, p. 399).
Cronbach's alpha ( $\alpha$ )	A statistical test commonly used to measure reliability (Internal consistency) (Adamson and Prion, 2013c; Downing, 2004).
Debrief	A formal, collaborative, reflective process that follows an SBE experience, which is led by a facilitator who encourages the participants' reflective thinking and provide feedback about their performance (Lopreiato et al., 2016).
Deliberate practice (Framework)	A theory of general psychology developed by Anders Ericsson that states the differences between expert performers and normal adults reflects a life-long period of deliberate effort to improve performance in a specific domain. It involves engaging learners in well-defined learning objectives or tasks, set at an appropriate level of difficulty, and opportunities for focused, repetitive practice with expert feedback (Ericsson, 2004; Lopreiato et al., 2016).
Dependant variable	Is the term used to donate the variable that is not manipulated during an experimental study, therefore its value depends on the variables that have been manipulated (Field, 2013, p. 873).

DH	Department of Health
Durbin-Watson calculation	Undertaken to assess the assumption of independent errors where there is no correlation in the residuals of the independent variables and they are therefore independent of each other (Field, 2013, p. 311).
Effect size	Effect size is an index that quantifies the degree to which the results of a study should be considered. It is a useful indicator of the practical importance of research results (Hojat and Xu, 2004).
Facilitator (Simulation Facilitator)	An individual who is involved in the implementation and/or delivery of an SBE activity (Lopreiato et al., 2016).
Feedback	An activity where information is relayed back to a learner with the intention of improving the understanding of concepts or aspects of performance (Lopreiato et al., 2016; Meakim et al., 2013).
Fidelity	The degree to which an SBE experience replicates a real event and/or workplace, which includes physical, psychological, and environmental elements (Lopreiato et al., 2016).
<i>F</i> statistic	The ratio of the variability in the scores that can be explained by a regression model compared to the residuals in the model that it cannot explain (Field, 2013, p. 302).
Greenhouse-Geisser estimate	A correction factor used for addressing violations in sphericity in repeated measure designs (Polit, 2010a, p. 401).
Homogeneity of variance/Homoscedasticity	The variation in the scores of the dependent variable is equal across all the groups being studied (Field, 2013, p. 174; Tolmie et al., 2011, p. 121).
INACSL	The International Nursing Association for Clinical Simulation and Learning

Independence	The data from the study groups are not influenced by each other and remain unrelated ( <a href="#">Field, 2013, p. 176</a> )
Independent variable	The variable that is the hypothesised cause of or influence on the dependant variable (Polit, 2010a, p. 402).
Interclass correlation	A correlation coefficient that assesses the consistency between measures (Field, 2013, p. 877).
Interrater reliability	A coefficient indicating agreement between raters (Polit, 2010a, p. 402).
Immersive Simulation	A real-life situation that deeply involves the participants' senses, emotions, thinking, and behaviour; creating an immersive simulation depends on the alignment with learning objectives, the fidelity of the simulation (physical, conceptual and emotional), and participant's perception of realism (Lopreiato et al., 2016).
Knowledge	One of the dependent variables in the study, and refers to the process of applying theoretical knowledge into practical knowledge (Anderson et al., 2008; Korthagen and Kessels, 1999; Spouse, 2001).
Kurtosis	Refers to how flat or pointed the peak is of a frequency distribution curve (Polit, 2010a, p. 402).
Laboratory setting	I defined, for the purpose of my thesis, as a study that was undertaken outside the participants existing programme where they volunteer to participate in an educational intervention that they would not receive as part of their normal learning and teaching activities.
Learning curve	A learning curve describes the improvement in performance, mathematically or theoretically, that

	occurs through task repetition or experience (Glocka et al., 2018).
Levene's test	A statistical test used to assess the assumptions of homogeneity of variance/homoscedasticity. It tests the null hypothesis that the variances in both groups are equal (Polit, 2010a, p. 120). If not statistically significant equal variance can be assumed and the null hypothesis that both groups are equal can be accepted (Cohen et al., 2011, p. 642).
Linearity	Linearity means that there is a straight line relationship between the dependent and independent variables (Field, 2013, p. 167; Polit, 2010a, p. 245)
Mann-Whitney <i>U</i> test	A non-parametric test equivalent to the independent <i>t</i> -test and can be used when the dependent variable is measured at an ordinal level. It is based on the relative ranks of the scores in each group (Field, 2013, p. 214; Plichta et al., 2013, p. 117; Tolmie et al., 2011, p. 128).
Manikin (Simulator)	Full or partial body simulators that can have varying levels of physiologic function and fidelity (Lopreiato et al., 2016).
Mauchly's test	Assesses the hypothesis that the variance of the differences between the conditions are equal (Field, 2013, p. 545; Polit, 2010a, p. 153).
MCQ	Multiple choice questionnaire
Mixed analysis of variance (ANOVA)	A statistical technique that calculates the differences between the means of three or more groups, the within-subject factor, and then between them, the between-subject factor. A mixed ANOVA is used when there is a combination of repeated measures and independent designs (Field, 2013, p. 592; Polit and Beck,

	2010, p. 415; Punch and Oancea, 2014, p. 314).
Multi-collinearity	Describes a correlation matrix where two or more independent variables are highly correlated with each other (Polit, 2010a, p. 404).
Multiple Regression	A statistical technique used to explore and analyse the relationship between variables and make predictions about their values and outcomes. When two or more independent variables are used to predict a dependent variable then this is termed multiple regression analysis (Cohen et al., 2011, p. 663; Freeman and Walters, 2010, p. 469; Plichta et al., 2013, p. 340; Polit and Beck, 2010, p. 422).
NMC	Nursing and Midwifery Council
Non-parametric test	A class of statistical procedures that do not rely on restrictive assumptions of parametric tests. In particular they do not assume that the sampling distribution is normally distributed (Field, 2013, p. 880).
Normal distribution	Refers to the assumption that the dependent variables are normally distributed in the population (Plichta et al., 2013, p. 69; Polit, 2010a, p. 103).
Paired <i>t</i> -tests	A statistical test using the <i>t</i> -statistic that establishes whether two means collected from the same sample differ significantly (Field, 2013, p. 880).
Parametric test	A class of inferential statistical tests that require four assumptions to be met a) normal distribution, b) independence, c) homogeneity of variance and d) interval or ratio data (Field, 2013, p. 881; Polit, 2010a, p. 405).
Participant	A person engaged in a simulation activity or event and for those involved in

	simulation research (Lopreiato et al., 2016).
Performance	A dependent variable in the study and refers to the observable evidence of an individual or team's achievement. It reflects and measures professional practice (Andreatta and Lori, 2014; Eraut, 1998; Fastre et al., 2010, p. 33; While, 1994).
Pre-brief	An information or orientation session held prior to the start of a simulation activity in which instructions or preparatory information is given to the participants. The purpose of the pre-briefing is to set the stage for a scenario, and assist participants in achieving scenario objectives (Lopreiato et al., 2016).
Predictor variables	In regression analysis the independent variable used to predict the value of the dependent variable (Polit, 2010a, p. 406).
Quasi-experimental design	A design that uses naturally occurring treatment groups to study dependent and independent variable relationships using the logic of experimental design (Punch and Oancea, 2014, p. 283).
Reliability	The consistency of the results obtained from a data collection instrument (Griffiths and Rafferty, 2010, p. 408; Kardong-Edgren et al., 2010; Lammers et al., 2008; Tolmie et al., 2011, p. 146).
$R^2$ (Adjusted $R^2$ )	The percentage of variation in the dependent variable that can be explained by the regression model from the study sample (Field, 2013, p. 302; Polit, 2010a, p. 214), with adjusted $R^2$ representing the variation in the model if the data was taken from the broader population (Field, 2013, p. 321).



Scenario (Clinical scenario)	The plan of an expected and potential course of events for a simulated clinical experience. Including the scripts, stories, or algorithms created for instructing the participants, including the simulators (human or robotic), on how to interact with the students. Also includes the context for the simulation (hospital ward, emergency room, operating room, clinic, out of hospital, etc.) (Lopreiato et al., 2016).
Self-efficacy	A dependent variable in the study and refers to a person's belief in their capability to organise and execute a course of action required to produce a given attainment (Bandura, 1997, p. 3).
Simulation using Team Deliberate Practice model (Sim-TDP)	The study's independent variable that incorporates the principles team deliberate practice into a simulation-based education approach.
Simulation-based education (Learning experience)	An array of structured activities that represent actual or potential situations in education and practice (Lopreiato et al., 2016).
Situational awareness	Situation awareness (SA) is the perception of environmental elements within time and space, and a perception of their meaning. It involves being aware of what is happening around you to understand how information, events, and your own actions impact the outcomes and objectives (Lopreiato et al., 2016).
Skewness	A measure of the symmetry of the frequency distribution. Skew occurs when the bulk of scores cluster at one end and then trail off at the other end (Field, 2013, p. 884; Polit, 2010a, p. 408).
Sphericity	Is the assumption that the variance in the group scores for any two time periods is the same as the variance for any other

	time period (Field, 2013, p. 545; Polit, 2010a, p. 153).
Statistical power	The ability of the test to detect a difference (Field, 2013, p. 69).
Taskwork team training	Taskwork team training concentrates on what team members are doing to achieve the teams' goals.as (Crawford and Lepine, 2013).
Team Deliberate Practice	<p>Deliberately undertake team practice in an effort to improve team performance e.g. soccer players (Ward et al., 2007).</p> <p>Team deliberate practice is based on the principles of deliberate practice e.g. well-defined learning objectives or tasks, set at an appropriate level, with opportunities for repetitive practice in teams with expert, coached, feedback (Helsen et al., 1998; Lund et al., 2013a)</p>
Team Training	Team training describes the set of tools and methods that can be used as an education strategy to enhance the capacity of group members to work more cooperatively toward their teams goals (Salas et al., 2008b).
Team work training	The behaviours that facilitate effective team member interaction and, team training, focuses on how the team actually interact with each other to accomplish the teams' goals (Beaubien, 2004; Crawford and Lepine, 2013).
Tolerance statistic	A statistical index used to detect multi-collinearity among independent variables (Polit, 2010a, p. 409).
Type I error	Occurs when an effect is detected when a relationship does not actually exist (Adamson and Prion, 2013b).
Type II error	Occurs when a difference is not identified when there actually is one (Adamson and Prion, 2013b).

Validity	Refers to whether an instrument actually measures what it is supposed to measure (Field, 2013, p. 12; Maltby, 2010, p. 245; Polit and Beck, 2010, p. 377). External validity refers to what degree the findings of a study can be generalised to other populations. Internal validity is the extent to which what is being observed truly represents the variable under investigation (Topping, 2010, p. 139).
Variance inflation factors (VIF)	A measure of multi-collinearity indicating whether a predictor variable has a strong linear relationship with other predictor variables (Field, 2013, p. 886).

# Chapter one: Introduction

## 1.1 - Chapter overview

This thesis presents a study, undertaken as part of a Professional Doctorate in Education that explored the development of a new model of delivery for simulation-based education (SBE) and analysed its impact in an adult nursing pre-registration curricula. The desire to focus on this area of study stemmed from the growth of SBE as a learning and teaching methodology within nurse education, and as a nurse educator, it had become an integral part of my role. One that I was passionate about. As a result, at the beginning of my doctoral journey I was very interested in ascertaining the most effective approach to delivering SBE that would enhance student learning. This type of research has become increasingly vital, as it has become progressively more evident that although SBE, when compared to other learning and teaching methodologies, has been accepted as an effective approach, questions had been raised over the significant costs generated. As such, the use of SBE had become ever more difficult to justify especially within the finite resources available to deliver this methodology. Consequently, my interest lay in identifying an approach that would optimise performance whilst maximising the use of available resources.

The chapter aims to set the context of the thesis and give an insight into the research question and the research methodology used. It begins by introducing SBE as a learning and teaching methodology and outlines its historical development and the

drivers that led to its growing inclusion in healthcare education. It examines the theoretical underpinnings, proposes a working definition, and discusses these in relation to the integration of SBE into the adult nursing curricula at a North East university. The chapter continues by identifying the concept of deliberate practice (DP) and, in particular, team deliberate practice (TDP), as theories that could be used to enhance the delivery of SBE within healthcare curriculum. The chapter concludes by outlining the structure of the thesis.

## **1.2 - Background**

The use of SBE in the teaching of healthcare professionals, whether in a higher education institute, hospital environment or simulation centre has grown rapidly over the past decade (Bland and Tobbell, 2016; Nestel et al., 2016), outpacing the development of other educational approaches (Alinier, 2007; Alinier et al., 2006b; Cant and Cooper, 2010; Gaba, 2004; Harder, 2009; Jeffries and Spunt, 2008; McGaghie et al., 2010). In the United Kingdom (UK) this had been fuelled by concerns over patient safety especially in the wake of the Francis report (The Mid Staffordshire NHS Foundation Trust Public Inquiry, 2013), where public concerns regarding the quality and safety of healthcare provision were raised. Concerns had also been raised over the competence of healthcare practitioners, the effectiveness of teams and the systems and processes used in the delivery of healthcare (Oermann, 2011; Wilford and Doyle, 2006). Furthermore, The National Institute for Health and Clinical Excellence (2007) and The National Patient Safety Agency (2007) recommended that all healthcare staff should have the education and training to make sure that they have the competencies to monitor, measure, interpret and respond promptly to the deterioration in a patient's

condition. The Nursing and Midwifery Council (NMC) (2010, p. 18) echoed this stance and stated that all nurses at the point of qualification must be able to undertake an accurate patient assessment, recognise the early signs of clinical deterioration and provide appropriate and timely care to those patients at risk.

Thus the Department of Health (DH) (2008) identified that continuously improving patient safety should be at the top of the healthcare agenda for the 21<sup>st</sup> Century, and an important route to achieving this was through the medium of SBE (Chief Medical Officer, 2008). In recognition of this risk, a number of healthcare professional bodies (General Medical Council, 2015; NMC, 2007) advocated the use of SBE as an appropriate learning and teaching methodology to help prepare students for future practice. Furthermore, Kneebone et al. (2004) identified that due to the risk of errors occurring it was no longer acceptable for novice healthcare practitioners to gain their basic skills on real patients. One of the greatest benefits of SBE was that it affords opportunities to practice in situations that faithfully replicate important features of the real world environment (Rosen et al., 2008), and when fully integrated into health care education, provides a safe environment for learners (Kneebone et al., 2004). Additionally, Devita (2009) argued that SBE should be a core educational strategy because it was measurable, focused, reproducible, mass producible and, importantly, memorable. As a result, SBE began to play an increasingly vital role in the education of all healthcare professionals from pre-registration/undergraduate to post-graduate post-qualifying programmes (Cant and Cooper, 2010; McGaghie et al., 2010).

This was further supported by a growing evidence base for the efficacy of SBE. A greater understanding of the pedagogy began to emerge in the literature (Cook et al., 2012; Issenberg and Scalese, 2007; McGaghie et al., 2014; Shin et al., 2015b) and, a

number of systematic reviews and meta-analyses (Cook et al., 2011b; Fritz et al., 2008; Hegland et al., 2017; Laschinger et al., 2008a; Okuda et al., 2009) demonstrated the efficacy of this approach as a learning and teaching methodology. Despite this growing evidence base, a scoping exercise on the provision of SBE in the UK found that there was a wide variation in the quality of its delivery (Anderson et al., 2014). Anderson et al. (2014) identified that there was a clear need to develop the quality of SBE and increase the engagement of all healthcare professionals in its use. They recommended that it should be integrated into all healthcare curricula with robust, quality assured educational approaches that were underpinned by high quality pedagogic research (Anderson et al., 2014). This research should be aimed at exploring the SBE design features that enhanced learning at different stages in a student's educational journey (Cook et al., 2011a; Yuan et al., 2012). This was of particular interest as I was keen to identify the most appropriate methods for optimising the performance of student nurses within a higher education setting. This necessitated a detailed exploration of the concept and origins of SBE.

### **1.3 – Simulation based Education**

The history of SBE stretches back over centuries with the military adopting this approach through various activities, for example jousting, and war games such as chess to develop battlefield skills (Bradley, 2006). In terms of healthcare education, the development was much slower and commenced in the early 20<sup>th</sup> Century, with the development of part task trainers such "Resusci-Anne®" (Laerdal Medical, Stavanger, Norway). Progressing to the development of more sophisticated human patient simulators, which were computerised manikins capable of reproducing many human physiological responses (Bradley, 2006; Harder, 2009; Rosen, 2008). However, Gaba

(2004) asserted that SBE was not just a technology and highlighted that in fact it was an educational technique that incorporated many learning and teaching methodologies. These ranged from part task trainers and human patient simulators to standardised patients, actors/role players, virtual, mobile and e-learning. This seminal paper broadened the scope of SBE as a learning and teaching methodology. As a result, it has not only been used to develop technical skills but has also been used to develop non-technical skills related to human factors training such as team working, decision making, assertiveness, and communication skills, together with the development of situational awareness and an understanding of the impact of mental workload on practice (Flin et al., 2010; Leonard, 2004; NHS Institute for Innovation and Improvement, 2010; Patient Safety First, 2009; WHO Patient Safety, 2009). Accomplishing the latter was achieved by using fully immersive clinically relevant uni-professional and multi-professional scenarios that represented healthcare practice in a range of different clinical environments (Beaubien, 2004; Griswold et al., 2012). However, the breadth of educational methodologies that SBE covered posed a problem in identifying a clear working definition to guide my research study.

### **1.3.1 – SBE definition**

SBE has been defined by various authors, including Gaba (2004, p. i2), who in his pivotal paper defined it as “...a technique, not a technology, to replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion”. This definition clearly recognised SBE as an educational approach that was not solely based on a particular technology, but rather it aimed to replicate a real world event. This was further added to



by Jones and Alinier (2009, p. 9) when they defined SBE as a “...scenario-based clinical practice situation performed and facilitated within a safe and controlled environment using either low, intermediate, or high-fidelity approaches in order to actively enhance the students’ learning and clinical performance.” This added a number of key elements to the definition, including the concepts of fidelity, facilitation and the need for a safe and controlled learning environment. They also highlighted that it should be learner centred and focused on the learner’s development needs.

Alinier and Platt (2014) further built on this by identifying that SBE was an actual process that should not to be confused with a “tool” or “means”, called the “simulator”, used to achieve, evaluate or assess the intended cognitive, behavioural or psychomotor learning outcomes. Huang et al. (2008, p. 191) combined these attributes in their definition stating that SBE was “...a technique that uses a situation or environment created to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions and behaviours”. As this captured the many facets of SBE, I adopted this as my working definition. With this established I then explored the actual methods of delivery.

### **1.3.2 – The SBE process**

Classically, the delivery of SBE has included the following three stages: the pre-brief or briefing, the clinical scenario and the debrief (INACSL Standards Committee, 2016c; Lioce et al., 2015). In the pre-brief effective preparation of participants has been

acknowledged as being a vital aspect of SBE. To achieve this the aims, objectives and expectations need to be clearly articulated, together with an outline of roles (INACSL Standards Committee, 2016b; Kardong-Edgren et al., 2008; Lioce et al., 2015; Lioce et al., 2013). The next stage encompasses the scenario. Lioce et al. (2015) described this stage as an immersive representation of a clinical situation that the participants may encounter during their clinical practice. Finally, the debrief stage, an essential feature of SBE vital to the development of learners (Decker et al., 2013; Fanning and Gaba, 2007; INACSL Standards Committee, 2016a; Issenberg and Scalese, 2007; Issenberg et al., 2005; McGaghie et al., 2010; Rudolph et al., 2006). A belief further stressed by both Issenberg et al. (2005) and McGaghie et al. (2010) in their SBE meta-analyses when they found that of the twelve aspects of best practice feedback was the most important.

Outside the SBE arena feedback has been described as being central to supporting cognitive, technical and professional development (Archer, 2010) and has a number of purported benefits including increased confidence, motivation and self-esteem, as well as improved clinical practice (Clynes and Raftery, 2008). It also underpins many educational theories such as DP (Ericsson, 2004), cognitive apprenticeship model (Collins et al., 1989) and the zone of proximal development (Vygotsky and Cole, 1978). As such, it has become an integral part of the education process (Schartel, 2012) and recognised by healthcare regulatory bodies as a crucial component of professional educational programmes, for example the NMC (2018b) and the GMC (2015, p. 26). However, the provision of feedback has been described as a complex (Archer, 2010) and, as a result, there has been considerable interest in the healthcare and educational literature on the components of effective feedback, for example, its guiding principles (Ende, 1983; Shute, 2008), models of delivery (Cantillon and Sargeant, 2008;

Pendleton et al., 2003) and the sources of feedback (Clynes and Raftery, 2008; Frehner et al., 2012; Johnson et al., 2016; McPhee et al., 2017). van de Ridder et al. (2008) defined feedback as the “specific information about the comparison between a trainee’s observed performance and a standard, given with the intent to improve the trainee’s performance”. This interpretation appeared to view the feedback communication process during as a one-way process (Krackov, 2011; Sawyer et al., 2016). Interestingly, Sawyer et al. (2016) observed that the term feedback and debriefing were often used interchangeably and contended that they were in fact two distinct processes.

In contrast to feedback, debriefing has been viewed as a learner centric approach aimed at engaging the learner in a conscious consideration of their performance, and through the guidance of a skilled facilitator, reflect on their performance and develop a new understanding that they could apply to their future practice (Decker et al., 2013; Dreifuerst, 2009; Raemer et al., 2011; Rudolph et al., 2006; Rudolph et al., 2008). Fanning and Gaba (2007, p. 116) defined debriefing as “facilitated or guided reflection in the cycle of experiential learning”. A definition related to Kolb’s experiential learning theory (Kolb, 2015, pp. 31-64), which hypothesised that learners moved through four phases in the learning process. Starting with a concrete experience followed by the learner reflecting on their experience that enabled abstract conceptualisations to be formed before finally moving to active experimentation. In terms of SBE, it can be inferred that the scenario has given the learner the concrete experience and the subsequent debrief permits them to reflect and develop their abstract concepts. Thus, learning through debriefing has been seen as an active process dependent on the integration of experience and reflection (Decker et al., 2013; Reed, 2014, p. 125). This allows learners the opportunity to “reflect on action” (Schön, 1990, p. 26) that can be

enhanced by the creation of a safe learning environment (Rudolph et al., 2014). In doing so, the learner has an opportunity to explore their internal decision-making processes and constructively critique their own performance. Accordingly, it has enabled them to make sense of their experiences and own their learning, which can be synthesised into new insights and perspectives that can be applied to clinical practice (Jeffries and Rizzolo, 2006; Reed, 2014, p. 125; Sweeney, 2009). This could occur during the SBE scenario (Within-event) or following it (Post-event) allowing learners immediate feedback on their performance (Decker et al., 2013; Sawyer et al., 2016).

Reflection upon experiences becomes a powerful way to promote learning (Reed, 2014, p. 125) and, to ensure its continued effectiveness by encouraging participants to reflect, the use of a structured debrief has become essential (Decker et al., 2013; Der Sahakian et al., 2015; Jones and Alinier, 2006). A number of debriefing models have been developed to provide this structure, ranging in design from three (Jaye et al., 2015; Steinwachs, 1992; Zigmont et al., 2011) and four phases (Cheng et al., 2016; Eppich and Cheng, 2015) through to multiple phased models (Dreifuerst, 2015; Lavoie et al., 2015). The model chosen depends on the learning outcomes of the SBE activity and the participant and team characteristics (Fanning and Gaba, 2007). To optimise learning, Fanning and Gaba (2007) advocated that the approach to debriefing should also be tailored to the level of each set of learners. Therefore, a vital element and, one that would be needed to be fully incorporated into any new design feature. In order to achieve this the application of SBE to nurse education needed to be explored.

## **1.4 - SBE in nurse education**

Reflecting the changes across healthcare education generally the use of SBE in nursing curricula has increased greatly during the past two decades (Bland and Tobbell, 2016; Harder, 2009; Jeffries and Spunt, 2008). Although various SBE techniques have been used to teach nursing skills for decades Kardong-Edgren et al. (2008) noted that the recent increase in its use was due to the major advances in the technologies behind human patient simulators. Consequently, the use of manikin-based SBE has begun to play an increasingly important role (Alinier et al., 2004; McGaghie et al., 2010). This could also be attributed to the perceived benefits of this approach in nurse education.

### **1.4.1 – The benefits of using SBE in nurse education**

In nurse education a significant number of studies have found that SBE led to statistically significant improvements in the performance levels of students (For example Alinier et al., 2006a; Bowling and Underwood, 2016; Liaw et al., 2011; Liaw et al., 2012; Merriman et al., 2014; Stayt et al., 2015). A large number of other studies have reported that it improved the knowledge of students (For example Aqel and Ahmad, 2014; Kardong-Edgren et al., 2009; Luctkar-Flude et al., 2015; O'Leary et al., 2016; Shinnick and Woo, 2015), and that it increased their self-reported levels of confidence/self-efficacy (For example Ahn and Kim, 2015; Basak et al., 2016; Cummings and Connelly, 2016; McCabe et al., 2016; Nelissen et al., 2015; O'Leary et

al., 2016; Omer, 2016). In addition, a systematic review undertaken by Laschinger et al. (2008a) also found that SBE improved student motivation.

In a ground-breaking longitudinal, randomized controlled study undertaken by the National Council of State Boards of Nursing (NCSBN) no difference in the end-of-program educational outcomes of pre-licensure nursing students was found when up to 50% of clinical hours were substituted with high-quality SBE (Hayden et al., 2014b). The results led the authors to conclude that SBE was as effective in developing the competence and knowledge of pre-licensure nurses as the traditional programmes. The study compared the performance and knowledge of student nurses from ten pre-licensure programs across the United States of America (USA). Students were randomised into one of three study groups comprising those who had 25% of their clinical hours replaced by SBE and those who had 50% replaced by SBE. The control received the traditional clinical experience where SBE accounted for no more than 10% of the programme. A total of 666 students completed the study and Hayden et al. (2014b) found no statistically significant differences in clinical competency between the groups ( $p = 0.688$ ), or on follow up at three months ( $p = 0.511$ ) or six months ( $p = 0.527$ ).

This offered credible evidence of the efficacy of SBE in pre-registration nursing programmes, but due to the differences in the programme structure, the transfer of these findings to UK based education programmes needed to be undertaken with caution. The differences included the number of clinical hours the nursing students undertook in the USA, which for the NCSBN study was a minimum of 600 hours (Alexander et al., 2015), which equated to 300 hours of clinical hours being replaced. In

comparison, students in the UK undertake a three year program comprising 2300 hours of clinical practice learning (NMC 2010, pp. 8-9). They also need to meet the European Union (2005) requirements for training in general care, which states that practice learning must be undertaken in direct care of clients. However, in an amendment to this, the NMC (2007) had recommended that SBE could be used for up to 300 hours of practice learning similar to the hours recommended by the NCSBN study (Alexander et al., 2015). In terms of the overall UK based programme this only accounted for 13% of the total practice hours and, when compared to the NCSBN study (Alexander et al., 2015), equates approximately to the 10% hours specified for the control group.

Nevertheless, the study offered compelling evidence to the efficacy of SBE in nurse education. In a move that could enable nurse education providers to use more SBE to replace clinical hours the NMC in their recently published Standards for Pre-registration Nursing Programmes (NMC 2018a, p. 9; NMC 2018c, p. 10) effectively removed the 300 hours ceiling on SBE and instead recommended that SBE be used proportionately and appropriately to ensure safe and effective practice. Thus making the need for high quality SBE a greater imperative. As highlighted by Alinier (2007), a key factor to achieving this was how SBE was integrated into a curricula, which needed to be delivered at the right time and, in a manner that was effective and appropriate to the needs of the students.

#### **1.4.2 – Integrating SBE into a nursing curricula of a North East University**

A central feature of pre-registration nurse education has been the acquisition of a range of diverse clinical skills (Woolley and Jarvis, 2007) with the nature of how these

are delivered determined by the individual institution (NMC, 2010). Therefore, the aim in a University in the North East of England was to embed SBE throughout the three years of an adult nursing curriculum. However, introducing SBE into a curricula has been reported as being complex and fraught with problems (Starkweather and Kardong-Edgren, 2008). To overcome this Leigh and Hurst (2008) recommended that a progressive approach should be undertaken that were underpinned by sound theoretical theories (Jeffries and Spunt, 2008) together with the most effective SBE design (Josephsen, 2015; Ricketts, 2011).

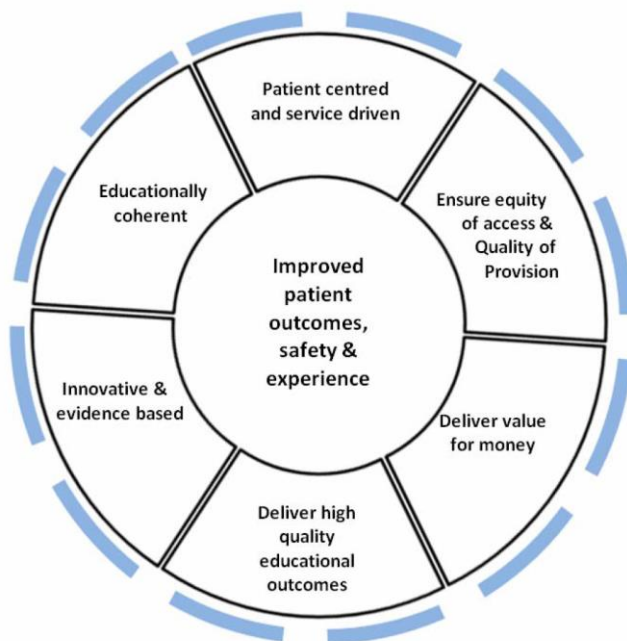
In the UK, to assist this process the DH (2011) published the Framework for Technology Enhanced Learning (TEL), which described six key principles to support the successful implementation of SBE into programmes (Figure 1). These principles stated that SBE programmes should use innovative and evidence-based educational practice to deliver high quality educational outcomes that were patient centred and met the needs of the healthcare service whilst providing value for money and equity of access to all healthcare (DH 2011). These principles were further supported by the Education Outcomes Framework (DH 2013), which called for the highest standards of education and training that were pedagogically coherent and innovative.

#### **1.4.2.1 – SBE curricula structure**

In keeping with these educational principles, I developed an SBE curricula strategy that followed a constructivism philosophy and employed the spiral curriculum theorem (Bruner, 1977). The basic premise of the strategy was that students in year one developed their cognitive and psychomotor skills, mainly through part task trainers e.g.



Figure 1: Technology Enhanced Learning Framework (DH 2011)



basic life support, bed bathing and injection technique before moving into years two and three. In these latter years, SBE focused on developing their clinical reasoning, decision-making, problem solving and psychosocial skills. This was achieved through active engagement in increasingly immersive scenarios (Alinier, 2007; Campbell and Daley, 2009, p. 18) aimed at developing the student's capability or, as described by Eraut (1998), "everything a person can think or do". van Merriënboer and Sweller (2005) and van Merrienboer and Sweller (2010) noted that adopting a progressive approach to learning was an appropriate technique for novice learners because when they are confronted with highly complex materials they may become overloaded with learning materials.

A key theoretical model of the SBE strategy was the cognitive apprenticeship model (Collins et al., 1989, pp. 480-483). This model identified six stages of development;

namely, modelling, coaching, scaffolding, articulation, reflection and exploration. In this model, the nurse educator initially demonstrated a practical skill before progressing to the first SBE sessions where they coach the student and scaffold their learning (Collins et al., 1989, p. 482; Wood et al., 1976). Woolley and Jarvis (2007) argued that this approach was essential to prepare students for clinical practice as it offered them supervised opportunities to practise and develop their skills in a safe and controlled environment. Interestingly the concept of rehearsing skills under supervision related to the theory of DP and the DP Framework (Ericsson 2004).

#### **1.4.2.2 – Integrating deliberate practice and SBE into a nursing curricula**

A number of authors (Bond et al., 2008; Chee, 2014; Clapper and Kardong-Edgren, 2011; Issenberg and Scalese, 2007; McGaghie, 2008; McGaghie et al., 2014; McGaghie et al., 2010) posited that this approach was key to boosting skills and knowledge acquisition in educational programs. A systematic review by McGaghie et al. (2010) found clear evidence that repetitive practice involving SBE was associated with improved learner outcomes. This was especially so when learners were given tasks that had well-defined goals and were provided with feedback that motivated them to improve (Ericsson et al., 1993). In fact, the best training situations were those that included immediate feedback, reflection, and correction (Ericsson, 2008) that also incorporated opportunities to rehearse and refine performance until it could be completed with consistent success and a progressively higher level of performance is achieved (Ericsson, 2008; Ericsson et al., 1993). In essence, DP can be described as an educational approach that engages learners in repetitive learning activities that have well-defined learning objectives or tasks, set at an appropriate level of difficulty and

represent clinical practice, with expert feedback immediately available (Ericsson, 2004; Lopreiato et al., 2016; McGaghie, 2008). A description that provides a working definition of DP for my study.

Clapper and Kardong-Edgren (2011) reasoned that nursing would benefit from implementing DP into programmes to improve the performance of nurses. The challenge was therefore how to incorporate DP into an adult nursing curricula. Whilst Ericsson (2008) identified that SBE with DP provided learners with opportunities to improve their performance the delivery of this framework was constrained by the availability of resources. These limitations included the availability of specialised SBE rooms and equipment, curricula time restrictions and the availability of appropriately trained staff with the relevant SBE expertise (Al-Ghareeb and Cooper, 2016; Aldridge, 2016). These constraints combined with large student cohorts meant that SBE delivery posed a significant challenge to implementing SBE following the principles of DP. To overcome these constraints, SBE was delivered in small groups of four to six students and not on the individual basis advocated in DP (Ericsson, 2004). Therefore, it was imperative to find the most effective approach that would enhance learning using SBE (Kardong-Edgren et al., 2015) whilst achieving a balance between this and maximising resources.

#### **1.4.2.3 – The evolution of the Simulation using Team Deliberate Practice model**

A broader review of the literature identified that a number of professional teams also used the DP and, in terms of teams, refers to the deliberate undertaking team of

practice in an effort to improve the team's performance e.g. soccer players (Ward et al., 2007). Based on the principles of deliberate practice, Team DP (TDP) thus combines well-defined learning objectives or tasks, set at an appropriate level, with opportunities for repetitive team practice under the expert supervision of a coach who provides immediate feedback (Helsen et al., 1998; Lund et al., 2013a). This offered a working definition of TDP for my study. Harris et al. (2016) contended that team DP (TDP) provided a framework for implementing team training in healthcare, and provided a solution to the challenges faced by nurse educators in resourcing SBE. However, very few studies had been undertaken in healthcare education in this area, and particularly in nurse education. A gap in the literature, therefore, existed, which raised the challenge of incorporating TDP into SBE. To meet this challenge, I developed an innovative educational approach to SBE based on the literature reviews grounded on the TDP approach entitled Simulation using Team Deliberate Practice (Sim-TDP) (Appendix 1).

The Sim-TDP model followed the standard three-stage SBE approach but differed during the debriefing stage. Traditional debriefing enables participants to review and reflect on their performance under the guidance of an expert facilitator. Learning points are explored and action plans are developed to direct future development. Regardless of the debriefing model participants are not provided with any further opportunities repeat the scenario and apply their new learning objectives. However, the Sim-DTP model would provide a small team of participants further opportunities to repeatedly undertake the scenario. At the end of the "traditional", first, debrief the participants would undertake a "walk through" of the scenario in the actual SBE environment. At this point, under the guidance of an expert facilitator using the within-event debriefing approach, their learning needs and action plans from the first debrief would be

explored. Once completed, they would then repeat the scenario before undertaking a final debrief. To provide evidence of the efficacy of this model I, in keeping with the principles set out by the DH (2011), undertook this research study. A study that compared two different SBE approaches to identify the design features that, not only enhanced learning, but were appropriate for the educational stage of the learners (Cook et al., 2011a; Yuan et al., 2012). This study, therefore, was designed to assess the value of the Sim-TDP model as a learning and teaching approach. However, choosing the most appropriate research methodology has been acknowledged as a challenge, but by exploring our own values and past experiences helps to construct a personal philosophy that influences the way would undertake research (Harper and Hartman, 1997, p. 46).

## **1.5 – An overview of the research methodology**

As a nurse, I felt comfortable with the qualitative paradigm with its humanistic ideology that was congruent with the discrete professional values of nursing (Green and Holloway, 1997) and this initially appeared to be the obvious approach to take. However, heeding the advice of Bryman (1984), who stated that a research study must reflect the appropriate epistemological framework I began to explore SBE, DP and TDP to ensure that I had the correct approach. The literature search highlighted that SBE was a complex learning and teaching methodology however, I was able to identify gaps in the literature and develop my initial research aim, which was to compare the effect of a TDP based SBE intervention, Sim-TDP, with those of a traditional SBE delivery, within a structured SBE strategy, on capabilities of second year adult nursing students.

In the process of developing this, I found that I had to reduce this complexity and focus on the component parts of my aim. This reductionist approach fitted more with a quantitative methodology (Topping, 2010, p. 130) and I continued by exploring the independent, Sim-TDP, and dependent variables, performance, confidence and knowledge of participants. During the discourse, I found that they aligned to an epistemology position that recognised knowledge as being grounded in science and that could be observed and measured (Maltby, 2010, p. 25). Once again a more quantitative approach. As van Merriënboer and Sweller (2005) stressed, experimental methods are needed to develop sound instructional theories and delivery designs that were capable of making a real difference to educational practice. This would also mean that I would have to adopt an objective independent stance detached from the participants (Harper and Hartman, 1997, p. 24; Polit and Beck, 2010, p. 15). This also resonated with my personal aim of developing an evidence based SBE approach that, through observation and measurement, would demonstrate that it optimised student performance and made a real difference to the delivery of SBE.

Using a quantitative approach would also meet the need to provide evidence to key stakeholders, for or against, the efficacy of SBE as a learning and teaching methodology (Lammers et al., 2008). The development of a robust evidence base that demonstrates the efficacy of SBE has been raised as a crucial challenge for SBE educators (DH, 2011; McGaghie, 2008; McGaghie et al., 2010; Okuda et al., 2009; Parker, 2009; Prion and Adamson, 2012). On a professional level, to ensure the competence of students at the point of registration (NMC, 2010) there has been an increased emphasis on outcome measures, which has led to an increasing use of quantitative methods (Topping, 2010, p. 138) further supporting my move to a quantitative methodology. The collective weight of these discussions led me to shift

my stance, philosophically, from a qualitative approach, to a quantitative approach to compare the impact of Sim-TDP, against a traditional SBE approach, through specific hypotheses testing (Boet et al., 2012) to provide the evidence base for the effectiveness of this approach.

However, since the study followed participants undertaking a nursing programme, it occurred in a realistic setting and not a laboratory environment. The latter, for the purpose of my thesis, I defined as a study that was undertaken outside the participants existing programme where they volunteer to participate in an educational intervention that they would not receive as part of their normal learning and teaching activities. This was a challenge as it made the undertaking of a true experimental design difficult. Nonetheless, following the assertions of Punch (2009, p. 219) who argued that by using a quasi-experimental method this approach would be possible in an educational setting. A pre/post design was adopted to enable the use of more powerful statistical tests (Boet, 2012), and this was further strengthened by the inclusion of a comparison group who undertook the traditional SBE to give a more robust understanding of the effect of Sim-TDP. A longitudinal approach with multiple data collection points was incorporated to explore the longer-term effects of the model compared to a traditional SBE approach (Boet et al., 2012; Seers and Critelton, 2001).

The overall aim of the research was to compare the effect of Sim-TDP compared to traditional SBE delivery, within a structured SBE strategy, on the performance, knowledge, and self-efficacy of second year adult nursing students. In keeping with the paradigm a number of hypotheses were developed that focused on addressing the effects of Sim-TDP over time and the effects that occurred during each phase. Combined these would explore whether or not providing opportunities to rehearse skills

using TDP would enhance the performance, knowledge, and self-efficacy of participants, whilst maximising the available resources. In addition, to address the issues around recognising the deterioration in patients the impact of Sim-TDP on time on task would be compared to the effect of a traditional SBE approach. This thesis describes the development and implementation of the study to test these hypotheses.

## **1.6 – Thesis structure**

So far, this chapter has outlined the context of the thesis including the development of SBE as a learning and teaching methodology and how it was embedded into the three-year adult nursing curriculum. The use of DP and TDP was also discussed and an overview of the development of the Sim-TDP innovative SBE model. The research methodology was introduced and briefly outlined and the research aim and hypotheses presented.

Chapter two provides a detailed three-stage review of the literature pertaining to the concept of DP. The first stage was a narrative review of the general DP literature aimed at increasing my understanding of the concept. It identified the key educational elements that form the foundation of this theory. This was followed by a more structured and systematic review of the healthcare DP literature that aimed at exploring the impact and efficacy of DP on educational outcomes. During this process, the concept of TDP was also highlighted as a potential approach that could be used to enhance student learning. However, the evidence was mainly found in the sports literature. A gap in the nursing literature related to both the concepts of DP and TDP



was identified. To maintain the currency of the literature review, the third stage involved updating and reviewing the literature on a regular basis in an iterative manner.

Chapter three provides a detailed debate to justify the research methodology and the underpinning philosophical stance adopted. In the process, exploring the ontology and epistemology of the various research paradigms and following this provides a rationale for the choice of a quantitative approach. It also offers an overview and rationale for the quasi-experimental pre-test/post-test design subsequently adopted.

Chapter four outlines the various stages in the research process and starts by discussing the issues around sampling before moving on to the design of the study. It explores and operationalises the independent and dependent variables and establishes the research question and posits the resulting hypotheses. It provides an in depth discussion related to the development of the performance, self-efficacy and knowledge data collection tools and in particular a detailed decision making trail that provides justification for the finalised tools. To end it covers other methodological considerations such as the ethical underpinnings of the study.

Chapter five presents the data analysis methods, including the process adopted, the statistical tests used and the rationale for their choice. The tests adopted included mixed ANOVA, independent and paired *t*-tests and the Mann-Whitney *U* test. A series of multiple regression analyses were also used to identify any predictor variable effects on the dependent variables. Due to the need to present the diagnostic tests for missing data, outliers, bias and violations of assumptions, the chapter presents the findings based on each of the dependant variables rather than per phase. It therefore presents

the findings for the participant's performance first, followed by the self-efficacy and finally, the knowledge results.

Chapter six explores the impact of the Sim-TDP intervention, compared to the traditional SBE approach, on the participant's performance, self-efficacy and knowledge and critically analyses the findings in the context of both the SBE and the educational literature. It concludes by making a number of recommendations for SBE practice and research.

Chapter seven concludes the thesis and also charts my doctoral journey. It starts by revisiting the rationale for the study before moving on to restating the research question, summarising the key study findings and outlining its distinctiveness and contribution to the SBE body of knowledge. This includes the development of the Sim-TDP model, and the chapter continues by detailing how this innovative model could optimise performance whilst maximising resources. It highlights the enormous potential that it has to transform SBE delivery across healthcare education. It discusses the limitations of the study and summarises the key recommendations for both SBE educational practice and research. The chapter ends with my reflexive account of the study and dissemination plan.

## **1.7 - Chapter summary.**

This chapter set the context of the thesis and introduced SBE as a learning and teaching methodology, including its historical development, and explored the concept so develop a working definition. The drivers and theoretical underpinnings for its inclusion in healthcare education were identified and discussed in relation to its integration into a nursing curriculum. Further, the concepts of DP and TDP were introduced, a gap in the healthcare literature related to their use in nurse education was subsequently identified, and the key theoretical elements explored. These formed the foundation of Sim-TDP, an innovative model proposed to enhance the delivery of SBE. The next chapter provides a detailed review of the literature pertaining to the concept of DP and TDP and identifies the key educational elements that form the foundation of this theory and those of Sim-TDP.

# **Chapter Two: Literature Review**

## **2.1 – Chapter overview**

The previous chapter outlined the development of SBE in healthcare education and explored the concept in order to provide a working definition and a discussion regarding how one university embedded it into their three-year adult nursing curriculum. Further, the concepts of DP and TDP were introduced and a model proposed that could further enhance the delivery of SBE within a curriculum, that of Sim-TDP. This chapter provides a detailed review of the literature pertaining to the concepts of DP and TDP and the impact and efficacy of these approaches on educational outcomes. This was conducted over three stages, the first of which was a narrative review followed by a structured review of the DP literature related to healthcare, which was extended to include TDP literature. It identified a gap in the healthcare literature related to the use of DP in nurse education and the use of TDP in healthcare education generally. Finally, the review was updated, in an iterative manner, throughout the study using article alerts.

## **2.2 - Deliberate practice literature review**

### **2.2.1 - Search strategy**

Polit and Beck (2010, p. 170) regarded a literature review as a crucial element to a quantitative study as it both increases the understanding of the subject area and aligns the proposed research to existing work. To conduct an effective literature search Lahlafi (2007) recommended that a focused research question should be formulated. To achieve this I felt that I had to gain a much deeper understanding of the concept of DP and its application to education generally. This necessitated undertaking the literature review in a number of stages. During the first stage, I aimed at developing a comprehensive understanding of DP as a theoretical concept by undertaking a narrative review as it provided an effective overview and summary of the subject. I was then be able to draw an appropriate conclusion of its application (Bettany-Saltikov, 2012, p. 8; Cronin et al., 2008).

A good literature review gathers information from a range of sources (Cronin et al., 2008). To this end, I used the Northumbria University search engine that incorporated a wide range of databases including MEDLINE (EBSCO and ProQuest), Cumulative Index to Nursing & Allied Health (CINAHL), Education Resources Information Centre (ERIC), PsycARTICLES and Web of Science. To capture the early literature on DP, I set a broad timeframe for the search that included literature from 1990 to 2013. To maintain focus at this stage, especially as the literature database was large, I followed the advice of Cronin et al. (2008) who advocated that researchers should use the review method developed by Cohen (1990), which was to preview, question, read, and summarize (PQRS) the literature. This process enabled me to formulate a research question using the PICO framework identifying the population (P), the intervention (I), the comparative intervention (C), and the outcomes (O) that were to be measured (Bettany-Saltikov and Whittaker, 2014). This led to the initial research question, which

was what was the effect of an SBE approach that incorporated DP on the performance, knowledge and confidence of healthcare practitioners?

Immersion in the DP literature enabled me to move to the second stage of the review that of undertaking a more comprehensive search based on the research question. To provide a high quality review and decrease the risk of error, I used a very structured, systematic and explicit approach (Polit and Beck, 2010, p. 172; Pryce-Miller, 2015). As recommended by Punch and Oancea (2014, p. 123) I adopted a five stage approach to this process, which included a) searching the literature using a clear strategy and then b) screening the literature. Once completed I then, c) summarised and d) analysed and synthesised the chosen literature. The final stage was e) where I wrote up the review. In the search strategy (Figure 2) I, therefore, used an explicit and rigorous criteria that identified the relevant literature and included clear inclusion and exclusion criteria (Table 1) and an appropriate timeframe, 1990 to 2013 (Cronin et al., 2008; Pryce-Miller, 2015). As recommended by Centre for Reviews and Dissemination (CRD) (2009, p. 15) the inclusion and exclusion criteria were set using the PICO framework as a guide. In relation to the population, I used the term healthcare education to capture all healthcare professional groups and organisations. To ensure a clear focus was maintained I used the terms simulation-based education and DP activities were used respectively for the intervention and the comparative intervention elements. To reduce the risk of bias during the selection of papers (Higgins and Green, 2011) and, improve the quality of the review, I used the hierarchy of evidence outlined by the Oxford Centre for Evidence-based Medicine (Howick et al., 2009) to guide the extraction of articles for the outcome element. Levels 1 – 4 were chosen to set the inclusion criteria to capture peer reviewed papers encompassing systematic reviews, meta analyses, quantitative and qualitative studies. Thus, level 5 was used to set the exclusion criteria, which included descriptive and/or opinion papers as well as programme or course evaluation

papers. To prevent repetition of data duplicate studies were removed. Due to the lack of resources for translation I chose to exclude non English articles from the literature search and acknowledge that this could bias my review (CRD, 2009, p. 12).

Table 1 - Inclusion and exclusion criteria	
Inclusion criteria	Exclusion criteria
Healthcare education	Descriptive and/or opinion papers
Simulation-based education	Programme or course evaluations
Deliberate practice	Duplicate studies
Peer reviewed journals	Non English journals
English full text articles	
Research studies reporting quantitative data	
Research studies reporting qualitative data	
Systematic reviews and meta analyses.	

To undertake the DP search, I once again used the Northumbria University search engine to explore the healthcare education literature. This included MEDLINE (EBSCO and ProQuest), Cumulative Index to Nursing & Allied Health (CINAHL), PubMed Central and Web of Science. I then purposefully selected a number of key words that reflected the research question; these included, deliberate practice, simulation,

**Figure 2 – Literature search strategy and study selection process**

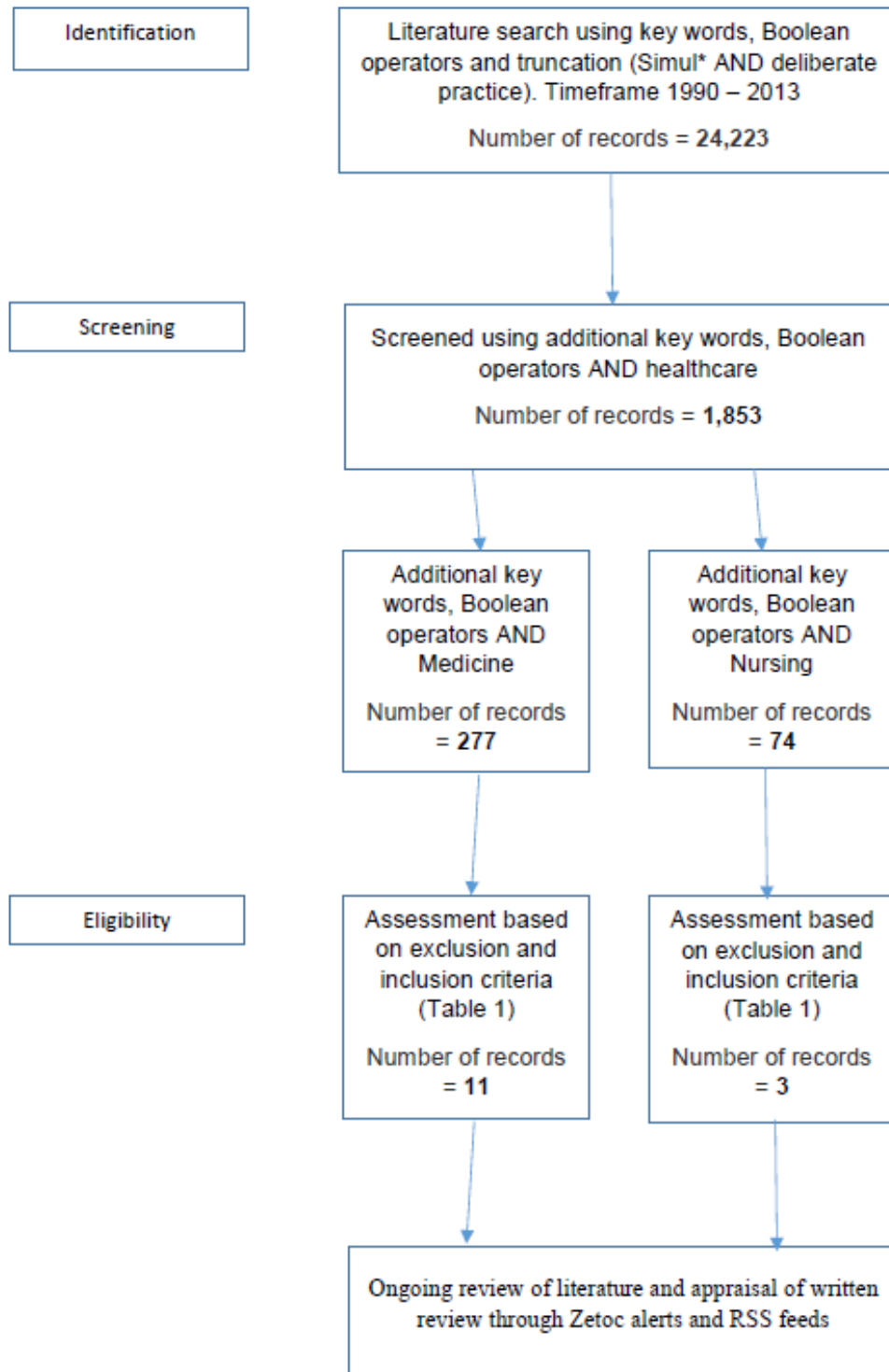




Table 2 - Search results							
Terms	<i>deliberate practice</i>		<i>Healthcare</i>		<i>Medicine</i>		<i>Nursing</i>
<i>simulation</i>	7,818	AND	769	AND	127	AND	47
<i>simulation based education</i>	3,467	AND	569	AND	98	AND	43
<i>simulation based learning</i>	4,445	AND	580	AND	140	AND	89
<i>simulation based medical education</i>	1,942	AND	516	AND	99	AND	
Simul*	24,223	AND	1,853	AND	277	AND	74

simulation based education, simulation based learning, simulation-based medical education, education, healthcare, nursing and medicine. The search was improved further by combining the results for each individual key word using the Boolean operators “OR” and “AND” (Lahlafi, 2007). To ensure that I also captured all the relevant simulation keywords that shared the same root I used truncation (Polit and Beck, 2010, p. 175) entering Simul\* into the search e.g. deliberate practice AND simul\* AND Healthcare. Table 2 presents the results of the search. Following the process outlined by Punch and Oancea (2014, p. 123) the abstracts from each search were then read for their relevancy and if pertinent were accessed and the full article read. This was then analysed and synthesized to form the review. A number of tools were available to undertake this but, as the range of articles was broad and covered a number of methodologies including systematic reviews, randomised controlled trials and qualitative studies, I used the Critical Appraisal Skills Programme (2013) checklists to guide my analysis and synthesis of the evidence.

Once completed, I moved onto stage three, the continual reviewing and updating of the literature review. I used ZETOC alerts and RSS feeds to support this process. As this process was dynamic with new literature being published and new concepts being unearthed, the review had to be revised several times during the study. The latter occurred when the concept of TDP was discovered and, as a result, the terms team deliberate practice, shared deliberate practice and group deliberate practice were added. This iterative process informed the literature review for this chapter.

### **2.2.2 - Stage one: DP Literature review**

The goal of DP has been acknowledged as the achievement of constant skill improvement (Ericsson, 2008; Ericsson et al., 1993) and, consequently, there has been considerable interest in the concept and its application as a learning and teaching methodology (Ericsson et al., 2009; Ericsson and Neil, 1994; Ericsson and Ward, 2007; Rossano, 2003). In healthcare education it has been recognised as a key approach to boosting an individual's skill and knowledge acquisition (Bond et al., 2008; McGaghie, 2008; McGaghie et al., 2011; McGaghie et al., 2010; Motola et al., 2013). Anders Ericsson and colleagues (Ericsson et al., 1993; Krampe and Ericsson, 1996) first studied DP. They focused on the development of expertise, mastery learning and the individual characteristics needed to improve skills through progressively higher levels of attainment that would ultimately lead to expert performance. Grounded in information processing and the behavioural theories of skill acquisition and maintenance, it was hypothesised that improvements in performance were produced by changes in the cognitive mechanisms that mediate how the brain and nervous system controls performance (Ericsson et al., 2006, p. 698; Motola et al., 2013; Vandervert, 2007).

Ericsson (2006, p. 683) identified several factors that effected the level of professional performance an individual could attain including having extensive experience in their relevant professional field. However, he noted that this, in itself, did not lead to expert levels of achievement and postulated that any improvement depended on the deliberate efforts an individual undertook to develop their levels of performance. It was not just about how much a learner practiced but how they actually undertook that practice (Ericsson, 2004). In other words how they engaged in deliberate practice.

A skill initially developed by a learner has the potential over time to become increasingly automated, which leads to a subsequent loss in the conscious control over behaviour (Ericsson, 2008; Ericsson et al., 2009). When performance has reached this level of automaticity, additional experience does not improve performance (Ericsson, 2006, p. 694). To avoid this danger Ericsson et al. (2009) proposed that a learner should make deliberate efforts to improve their performance, which they argued, was achieved by engaging in increasingly challenging tasks that stretched their levels of performance. Enhanced further through the active setting of new goals to attain these higher levels of performance (Ericsson, 2006, p. 694; Ericsson, 2008). In the studies undertaken by Ericsson and colleagues (Ericsson et al., 1993; Krampe and Ericsson, 1996), DP was found to be a more powerful predictor of superior performance than experience or academic aptitude alone. These findings were substantiated by studies undertaken across a range of professional groups such as musicians (Krampe and Ericsson, 1996), chess players (de Bruin et al., 2008) and sport people (Baker et al., 2003; Helsen et al., 1998; Hodges et al., 2004).

#### **2.2.2.1 – Deliberate practice general overview**

Building on his study findings Ericsson (2004) developed a DP educational framework. The first component of his framework was the provision of well-defined goals (Ericsson et al., 1993) set just above the learner's current level of performance (Ericsson, 2008). Second, the provision of immediate feedback on the learners performance with time to explore their internal decision-making processes and constructively critique their performance in relation to the identified aims and objectives (Sweeney, 2009). Thus enabling learners to explore areas of good practice and those that needed further development. The generation of new goals increased motivation to improve, whilst acting as a catalyst to seek out new learning experiences (Ericsson, 2004; Ericsson, 2008). The best training situations, therefore, include immediate feedback, reflection, and correction (Ericsson, 2008), together with further opportunities to rehearse and refine performance until consistent success had been achieved (Ericsson, 2008; Ericsson et al., 1993). This discussion, therefore, provided a working definition of DP for my study. Essentially, DP was an educational approach that engaged learners in repetitive learning activities that had well-defined learning objectives/tasks, set at an appropriate level of difficulty, with expert feedback immediately available (Ericsson, 2004; Lopreiato et al., 2016; McGaghie, 2008).

The more I explored the theory the more congruent it appeared with the theoretical foundations that underpinned the SBE integrated nursing curriculum I had developed. It reflected the spiral curriculum model (Bruner, 1977), ZPD (Vygotsky and Cole, 1978, p. 86), the cognitive apprenticeship model (Collins et al., 1989, pp. 480-483) and the process of scaffolding learning (Wood et al., 1976). I was, therefore, very keen to integrate it into the curricula model. However, Ericsson et al. (1993) recognised that to reach expert levels of performance the process required 10,000 hours of DP. This in terms of a nursing curricula posed a significant challenge as the total number of hours

in could not exceed 4600 hours (NMC 2010). The feasibility of its application to healthcare education, therefore, warranted further exploration.

### **2.2.3 – Stage two: Deliberate practice in healthcare**

Within healthcare education the actual application of this theory had generated a great deal of discussion within the SBE literature (Ericsson, 2004; Ericsson, 2007; Ericsson et al., 2007; Issenberg and Scalese, 2007; McGaghie et al., 2009; Michelson and Manning, 2008; Schaverien, 2010). Ericsson (2008) himself noted that SBE incorporating DP could provide learners with opportunities to improve their performance as it provided a conceptual framework that could guide the use of SBE (Motola et al., 2013). Two meta-analyses undertaken by Issenberg et al. (2005) and McGaghie et al. (2010) of SBE in medical education, collectively spanning over forty years, found twelve aspects in the delivery of SBE that constituted best practice. DP was found to be the second most important feature, which was especially effective when the DP framework developed by Ericsson (2004) was used. Applying this to healthcare education would mean engaging learners in relevant skill-based activities that were set at an appropriate level with expert feedback being provided and further opportunities for skills rehearsal (Ericsson et al., 1993; Issenberg et al., 2005; McGaghie, 2008; McGaghie et al., 2010).

In relation to medical education, a number of research studies had investigated the impact of DP on learners. These included its use in the training of medical students where positive training outcomes were found in the development of basic surgical skills (Baxter et al., 2013; Kneebone and ApSimon, 2001), clinical skills (Reed et al., 2016), and cardiac auscultation skills (Butter et al., 2010). Other studies focused on qualified medical practitioners and found DP to be an effective approach in developing

communication skills during “handoffs” (Pukenas et al., 2014; Sawatsky et al., 2013), resuscitation skills (Barry et al., 2012; Braun et al., 2015; Cordero et al., 2013; Knowles et al., 2013; Niles et al., 2009; Wayne et al., 2006), and more advanced technical skills. The latter included skills such as lumbar puncture (Kessler et al., 2011), laparoscopic cholecystectomy (Palter and Grantcharov, 2011), intubation, arterial line insertion and rapid administration of pharmacotherapy (Schroedl et al., 2012).

The use of DP in medical education had also led to improvements in patient outcomes. Barsuk et al. (2009) implemented an SBE programme that incorporated DP as part of the training of medical trainees for the insertion of central venous catheters (CVC). They found that the program not only increased the residents’ skills in CVC insertion but also decreased the number of complications. Joyce et al. (2015) also found a significant reduction in blood product prescribing errors when they introduced a DP educational programme for medical trainees.

These results were further echoed in a meta-analysis undertaken by McGaghie et al. (2011) that spanned over twenty years, which compared traditional clinical medical education with SBE that incorporated DP. An overall effect size for the fourteen studies of 0.71 (95% confidence interval, 0.65–0.76;  $p < .001$ ) was found, and they concluded that SBE with DP was superior to traditional clinical medical education, especially when used to achieve specific clinical skills. A quantitative review of thirty-one SBE studies by McGaghie et al. (2006) used the average weighted effect size to standardise the learning outcomes of the studies and, found that when analysed using a one-way analysis of Variance (ANOVA), the number of practice hours undertaken had a statistically significant effect on the learning outcomes. The more practice hours undertaken the greater the increase ( $F_{(4, 27)} = 5.77$ ,  $p < 0.002$ ). They also found a strong association ( $\eta^2 = 0.46$ ) between the number of hours of SBE practice and the number

of hours spent in SBE practice, which accounted for nearly 50% of the variation in the average weighted effect sizes. McGaghie et al. (2006) concluded that repetitive practice involving medical SBE was associated with improved learner outcomes with more practice yielding better results.

### **2.2.3.1 - Deliberate practice in nurse education**

Due to the identified positive benefits of DP on the performance of medical practitioners Ericsson et al. (2007), Clapper (2011) and Clapper and Kardong-Edgren (2011) reasoned that nurse education would also benefit from utilising the DP framework. A review of the nursing DP literature revealed a growing interest in its application to nurse education. Gonzalez and Kardong-Edgren (2017) provided a very compelling narrative to its benefits and, although this was not research based they gave a very effective exemplar of its application to nurse education. In terms of research, a number of studies had been undertaken to explore the impact of DP on the performance of nurses. Using a cross-sectional, descriptive study Bathish et al. (2016) developed the Deliberate Practice in Nursing Questionnaire (DPNQ) to evaluate the engagement of qualified nurses in DP. It was developed following an extensive review of the literature that led to the establishment of six subcategories and, overall, twenty-four items. These included formal education, continuing education, self-regulated learning/self-development, professional certifications, precepting/teaching others, and professional organisation memberships. Content validity and reliability were established through an expert panel review and survey testing, with an inter-rater agreement of .92–.96 (80% reliability) and a content validity index of 0.94. Cronbach's alpha coefficient for the DPNQ was .660 (standardized, .703). Bathish et al. (2016) concluded that the DPNQ instrument was a promising DP measure that provided a unique way to examine nursing expertise. However, the study by Bathish et al. (2016) focused on the DP

characteristics of expert practitioners and although the DPNQ tool offered an encouraging measure of traits, it did not measure performance.

In relation to performance Zigmont et al. (2011) observed that students often wanted to repeat an SBE scenario, especially after the debrief, to apply their new learning and review their performance. Exploring this further Abe et al. (2013) used a repeated scenario design to examine the effectiveness of SBE in improving the competency of cardiovascular critical care nurses. They implemented a training programme that consisted of a number of lectures followed by skills training and SBE scenarios. They allocated twenty-four qualified Japanese nurses to one of four groups and each group undertook an SBE scenario, which was then repeated. During the scenarios, participants assessed their own technical skills using a performance rubric. Although the researchers described the tool, they did not discuss its validity or reliability and, as a result, their findings needed to be viewed with caution, since they could be open to bias. Nevertheless, Abe et al. (2013) found that all the groups had an increase in their scores following the second SBE scenario, but no statistical analysis was presented so the results again could not be validated. In addition, as there was no control group, the results could not be fully attributed to the intervention.

Scherer et al. (2016) undertook a quasi-experimental study that investigated the use of four different SBE strategies on the performance and knowledge of student nurses. They assigned eighty students to one of two research groups. The first group was a repeated SBE scenario versus just one exposure ( $n=40$ ). The second group participated in an SBE scenario versus the observation of an SBE scenario ( $n=40$ ). In relation to the first research group, the data was analysed using a paired and independent  $t$ -tests, which indicated that repeating scenarios resulted in statistically significantly higher scores in student knowledge ( $p = <0.001$ ) and clinical performance



( $p = <0.001$ ) (Scherer et al., 2016). However, a lack of rigor was evident in the study since the researchers who developed the tools did not discuss their validity and reliability, which meant that their findings need to be viewed with caution and limited their application to nurse education.

Nevertheless, both these studies offered an insight into the potential benefit of repeated SBE scenarios in nurse education. Exploring other DP components further Kutzin and Janicke (2015) introduced an innovative initiative they entitled Rapid Cycle Deliberate Practice (RCDP) into a resuscitation programme. In this model, participants undertook a resuscitation scenario, which was then followed by an opportunity to review their performance. This process was then repeated until all elements of the resuscitation procedure could be successfully completed. The researchers felt that this approach enabled the participants to build on their skills through repeated actions. They found that by incorporating RCDP into mandatory education it improved both the satisfaction of the attendees and improved their response to a cardiac arrest. Although a novel intervention, there was no statistical data available and, as a result, an informed evaluation of the findings could not be made, thus limiting its application.

In a more robust resuscitation study, Oermann et al. (2011) found that repeated skills practice improved the performance of nursing students. They adopted a randomised control trial design to examine the effects of a monthly practice programme on the cardio-pulmonary resuscitation (CPR) skills of student nurses at three, six, nine, and twelve months. 606 nursing students from ten schools of nursing in the USA participated in the study. After their initial CPR training, they were randomly assigned to an experimental group, who had six minutes of monthly CPR practice, or to a control group who had no practice. The performance data of the students was captured by the resuscitation manikins and analysed using a linear mixed model. Oermann et al. (2011)

found that over a twelve-month period the intervention group performed better than the control group in a number of elements of CPR, including the depth of compressions ( $F_{[1, 592]} = 4.77, p = 0.03$ ), and the actual percentage of compressions performed adequately ( $F_{[1, 592]} = 7.53, p = 0.006$ ). They also found a statistically significant difference in mean ventilation volumes ( $F_{(1, 592)} = 35.26, p < 0.0001$ ), with a higher percent of ventilations having adequate volumes in the experimental group ( $F_{[1, 592]} = 20.0, p < 0.0001$ ).

Liou et al. (2013) in another quantitative study used a pre-test – post-test design that explored the effect of a DP education program on the competence of nursing students in the final year of a two year registered nursing programme in Taiwan. The programme contained a number of DP elements including access to relevant training equipment, flexible time slots for skills practice and, throughout, there was an instructor available for assistance. An instructional nursing skills video was also provided to support the students' skill development. To measure the outcomes, data was collected using self-reported clinical competence questionnaire (CCQ). The CCQ was a 47-item Likert scale with each item having a 5-point scale that ranged from one (do not have a clue) to five (know theory, competent in practice without any supervision). In a previous study, the researchers developed the CCQ following a literature review and focus group discussions, but this was not reported in the paper in any detail. However, the content, construct, and concurrent validity were tested and a content validity index of 1.0 was found, which met the .80 requirement. Factor analysis showed that the CCQ explained 70.8% of the variance of clinical competence and, in terms of its reliability, it had a Cronbach's alpha of .98. Thus Liou et al. (2013) concluded that the CCQ tool was valid and reliable.

They collected data over two consecutive years with 256 participants undertaking the pre-test and 266 completing the post-test. The data was analysed using an analysis of covariance (ANCOVA) method and the normal distribution of the CCQ scores was ascertained using the Shapiro–Wilk test. The *F* statistic from the ANCOVA was not reported but their findings indicated that the participants who exhibited significantly higher post-test competence scores had previous nursing experience (95% CI., 94, 20.42,  $p = 0.03$ ), had practiced their skills by watching the videos (95% CI., .28, 17.96,  $p = 0.04$ ), and had higher pre-test competence scores (95% CI., .05, .30,  $p = 0.01$ ). The authors concluded that students who watched the videos and/or consulted with their instructors had higher scores on the CCQ, and reasoned that the use of DP increased competence. The results from these latter two studies added further weight to use DP in nurse education.

As in the medical literature the use of DP in nursing education had also demonstrated improvements in patient outcomes. Barsuk et al. (2015) implemented an SBE mastery learning curriculum on central venous catheter (CVC) care and maintenance for a group of qualified intensive care nurses ( $N = 49$ ). The intervention encompassed five skills related to CVC management including medication administration, injection cap changes, tubing changes, aspiration of blood, and dressing changes. The effect of the education intervention was evaluated using a pre-test/post-test design and the participants were assessed using a 72-item checklist. This was developed using the Delphi, Angoff and Hofstee methods for checklists design. Raters were trained on its use, but as there were no inter-rater reliability data included it was difficult to assess the reliability of this tool. The study participants also completed a self-confidence scale.

The data was analysed using the Wilcoxon Signed Rank test and Spearman's rank correlation coefficient test. Barsuk et al. (2015) did not discuss a rationale for the use of

these non-parametric tests, which raised the question of the normal distribution of the data. Nevertheless, at post-test, they found statistically significant improvements in medication administration (Pre-test median 46.2% to post-test median 100%,  $p = < .001$ ), injection cap changes (Pre-test median 73.1% to post-test median 100%,  $p = < .001$ ), aspiration of blood (Pre-test median 30.4% to post-test median 100%,  $p = < .001$ ), and dressing changes (Pre-test median 43.8% to post-test median 100%,  $p = < .001$ ). Sixteen percent of the participants had to undertake additional training and, interestingly, the researchers found that the total years in nursing, including ICU nursing, had a statistically significant negative correlation with medication administration pre-test performance ( $r = -0.42$ ,  $p = .003$ ). The researchers concluded that after the training programme, there was a statistically significant improvement in the performance of the participants in the maintenance and care of a CVC.

The studies above offer compelling evidence of the benefits of DP in nurse education but they had, by and large, focused on individual skills development. They did not address the use of DP in an SBE approach that incorporated the application of a range of skills in an immersive clinical scenario. This was recognised by Whyte and Cormier (2014) who observed that there were limited studies that addressed the use of DP in the broader context of patient care. In their quantitative study, Whyte and Cormier (2014) used a randomized control design to explore the efficacy of a DP intervention designed to enhance the levels of clinical performance in Senior Baccalaureate nursing students. They used a convenience sample of forty nursing students who they randomly assigned to either a control or experimental group. The study comprised a two-phase DP intervention that was designed to progressively increase the student's ability to recognise and respond to a deteriorating patient. In the first phase, the individual students from both groups undertook the scenario and provided a continuous verbal report of their actions. This enabled the researcher to quantify their cognitive

processes. The scenario was then repeated for the students to observe and reflect on the outcomes. Once they had accessed and reviewed any relevant clinical information e.g. clinical guidelines, the scenario was repeated. This whole protocol was then repeated for each of the four scenarios in the study. The students in the control group only completed the pre and post-test sessions. Whilst the students in the experimental group completed two further DP based training sessions at weeks one and three and then undertook their post-test with the control group at week six.

Whyte and Cormier (2014) collected data from multiple sources including a Deliberate Practice Questionnaire (DPQ), the student's verbal reports, and the direct observation of their performance. DPQ was composed primarily of open-ended questions and nine critical care nursing experts had established its face validity through an in-depth review. Video recordings were viewed and coded by two independent raters and a third was used as a moderator. All were trained to code the video data. A dependent samples *t*-test was undertaken to determine the effects of the DP intervention and the researchers found that the DP intervention resulted in a statistically significant improvement in a number of key aspects of the students' performance. These were the titration of medications, including dopamine ( $t(40) = 3.794, p < .05$ ) and norepinephrine ( $t(40) = 2.983, p < .05$ ). As well as the recognition of the deterioration in a patient's clinical condition, such as a dilated pupil ( $t(40) = 3.984, p < .001$ ), and bleeding from a surgical wound ( $t(40) = 2.110, p < .001$ ). The researchers concluded that the DP protocol resulted in substantive performance improvement.

Once again, these studies offered persuasive evidence of the efficacy of DP in nurse education. However, the sample sizes were small and the participants were either

academically high-performing students who had volunteered or, had been recruited to undertake the study. This could have led to potential bias in the results (Seers and Critelton, 2001), a limitation acknowledged by the researchers and, Whyte and Cormier (2014) recommended that a longitudinal study should be undertaken to ascertain the effect of DP on the performance of the students over time.

Overall, these studies pointed to the potential efficacy of the DP framework (Ericsson, 2004) in nurse education, especially under the coaching of a more experienced healthcare professional (Clapper and Kardong-Edgren, 2011). This certainly held true for many of the psychomotor skills that nurses had to develop such as CPR (Oermann et al., 2011), and intriguingly, the study by Whyte and Cormier (2014) broadened this view by including the development of the more complex skills needed in the recognition of a deteriorating patient. Yet despite this growing evidence base to support DP, the individual nature of its application was a challenge for healthcare educators, especially balancing large student numbers with the constraints in the available resources (Wilford and Doyle, 2006). The latter included the logistical restrictions placed by the design of curricula on delivery time, the availability of specialist SBE rooms and equipment, together with the availability of suitably trained staff that had the relevant expertise in SBE (Al-Ghareeb and Cooper, 2016; Aldridge, 2016). An additional challenge for educators was the need for healthcare practitioners not only to develop their individual skills, but also skills such as communication and interpersonal skills that would enable them to work effectively within a healthcare team (Harris et al., 2016). Kennedy (2011) identified that education and training should ensure that healthcare professionals were appropriately prepared to respond to a crisis situation.

Nadler et al. (2011) in their study found that the accuracy of an individual's clinical assessment depended not only on his or her individual knowledge and skills, but also on how effectively relevant clinical cues were communicated by other members of the team. Thus, each member's accuracy of assessment depended on the quality of the teamwork. Interestingly, the level of performance in team sports was also dependent upon the cohesive interaction among team members and this required not only individual training but also group or team training (Baker and Young, 2014). Although DP typically appeared to focus on individual performance, the use of the DP framework had also been adopted within a range of team sports. This followed the recognition that a wide range of skills needed to be developed to improve both individual and/or team performance (Baker and Young, 2014; Harris et al., 2016). Harris et al. (2016) proposed that team DP offered a framework for implementing team training in healthcare that could meet these challenges. An exploration of the potential application of team DP to healthcare education, therefore, was warranted. As a result, I extended the literature search to include Team Deliberate Practice (TDP). The new search terms added were team deliberate practice, shared deliberate practice and group deliberate practice.

#### **2.2.4 – Stage three: Team deliberate practice.**

##### **2.2.4.1 – Teams, teamwork and team training**

Prior to undertaking the search on TDP I felt that it was imperative to explore the literature surrounding the use of teams, especially as the participants in my study undertook the SBE activities in small uni-professional teams. Therefore, I undertook an additional search of the team based literature to develop my understanding of the

concept. Katzenbach and Smith (1993) described a team as a small number of people with complementary skills who were committed to a common purpose and set of performance goals who hold themselves mutually accountable. Team members need to interact with one another to successfully perform their team task, which Beaubien (2004) described as the defining characteristic of a team. In terms of healthcare, teams could be uni-professional or multi-professional (Schmutz and Manser, 2013) and, when working together on a team task, Salas et al. (2008a) referred to this as teamwork and effective teams and team working are essential in ensuring high quality and safe healthcare delivery (Dietz et al., 2014). Beaubien (2004) defined teamwork as those behaviours that facilitate effective team member interaction including communication, situational monitoring, and decision making. As it improves cognitive, affective and performance outcomes, as well as teamwork processes, team training interventions have become a very feasible approach for organizations to take to enhance their team outcomes (Salas et al., 2008b).

Salas et al. (2008b) described team training as a set of tools and methods that can be used as an education strategy to enhance the capacity of group members to work more cooperatively toward their teams goals. The aims of team training were therefore, to improve leadership, role identification, communication, collaboration, and coordination of complex teams and, through formative feedback, to support the transfer of training to the healthcare environment to ultimately improve patient-specific outcomes (Barsness, 2015; Weaver et al., 2014). Salas et al. (2008b) noted that this enabled team members to become aware of, learn about, and practice requisite team competencies and performance processes while receiving feedback on their performance. Consequently, there has been considerable interest in team training to enhance team working skills. A number of meta-analysis and systematic reviews have identified that team training had positive outcomes on the performance of teams (For example Barton et al., 2018; Kim



et al., 2018; McEwan et al., 2017; Murphy et al., 2016; Salas et al., 2008b; Schmutz and Manser, 2013) and across a range of clinical settings, such as, intensive care (For example Dietz et al., 2014; Low et al., 2018), surgery (For example Gillespie et al., 2010; Tan et al., 2014), emergency departments (Gjeraa et al., 2014). As well as studies at an undergraduate level (For example Garbee et al., 2013; Reising et al., 2017) and individual studies (For example Baker et al., 2015; Nelson et al., 2017). Collectively, these point to the efficacy of teamwork training as a means of improving team performance. Thus team training has been the most practiced strategy for enhancing team performance and improving team outcomes (Baker et al., 2006). To be effective McEwan et al. (2017) advised that teamwork training should incorporate experiential activities that provide participants with more active ways of learning, including SBE, that are engineered to expose participants to relevant team issues and interactions that enabled them to develop their team working skills (Palaganas, 2014, p. 177).

Salas et al. (2008b) identified three components to team training, which were taskwork, teamwork and a combination of both approaches. Salas et al. (2008a) defined taskwork as the components of a team member's performance that did not require interdependent interaction with other team members, or what team members are doing together with regard to task-focused activities (Crawford and Lepine, 2013). Taskwork team training, as Crawford and Lepine (2013) outline, concentrates on what team members are doing to achieve the teams' goals. In contrast, teamwork has been defined by as those behaviours that facilitate effective team member interaction (Beaubien, 2004) and, team training, focuses on how the team actually interact with each other to accomplish the teams' goals (Crawford and Lepine, 2013). These interactions, or non-technical skills, relate to the concept of human factors such as decision making, assertiveness, and communication skills, together with the

development of situational awareness and an understanding of the impact of mental workload on practice and, are crucial elements in the delivery of safe healthcare practice (Flin et al., 2010; Leonard, 2004; NHS Institute for Innovation and Improvement, 2010; Patient Safety First, 2009; WHO Patient Safety, 2009). Current team training focuses largely on these team behaviours (Pugh et al., 2014). However, Glickman et al. (1987) posited that teams progressed through several stages of development during the course of their training, and identified two discrete developmental tracks, the first being a taskwork track and the second a teamwork track. Salas et al. (2008b) agreed and described the interplay between these components as a taskwork - teamwork continuum and, as proposed by Glickman et al. (1987), for team training to be successful the two tracks need to be developed separately and then combined as learners progressed. Salas et al. (2008b) recommended further research into this taskwork – teamwork continuum, especially on which of these two elements should be taught first.

Given that teams develop along both a teamwork and taskwork track (Ilgen, 1999), Mathieu and Rapp (2009) argued that teams needed to establish a solid foundation for each track during the early stages of team development. McKinlay and Pullon (2014) agreed and believed that it was too late to start learning teamwork skills as a graduate practitioner. They reasoned that the development of clinical skills by novices was best achieved in a safe learning environment and, they felt that team working skills were no exception, this approach, they maintained, would allow new graduates to ‘hit the ground running’ with teamwork skills already well developed. Mathieu and Rapp (2009) suggested that this could be achieved by devoting time to developing teamwork approaches such as team charters, and taskwork approaches for example performance strategies that could lead, over time, to more effective team performance. Thus teaching students how to be effective team members at an undergraduate level

and equip them with the skills that could then be enhanced and mastered within the workplace (Britton et al., 2015).

However, exactly how this should be integrated into educational programmes Jeffcott and Mackenzie (2008) felt was not known. A point echoed by Nelson et al. (2017) who found, following a systematic review, that there was little evidence to indicate the best way to implement team training into an undergraduate/pre-licensure programme, and advanced that this included the long term effects this would have on practice.

Nevertheless, they recommended that, regardless of the instructional design, team training should be incorporated into healthcare curricula (Nelson et al., 2017). A point echoed by Masiello (2012) who advocated the integration of DP into surgical team training in order to enhance team-skills aspects. In terms of nursing, Barton et al. (2018) identified, in an integrative review, that the pedagogies most effective for building teamwork competency involved the use of SBE and debriefing as they were rooted in the theories of social constructivism. Tannenbaum and Cerasoli (2013) also identified debriefing as a key element of effective team training and Baker et al. (2006) added that learners should be afforded opportunities to practice the skills they have learnt, whilst receiving remedial feedback. These elements reflected Ericsson's (Ericsson, 2004) DP framework and Low et al. (2018) suggested that the required frequency of ongoing team training, for sustained clinical benefits, should be analysed through longitudinal research. A point corroborated by Riggall and Smith (2015) who found that a single SBE activity, as an interventional dose, was not enough and they called for a longitudinal study to be undertaken to determine the effectiveness of programmes following repeated sessions recommending that deliberate practice approaches should be explored. McKinlay and Pullon (2014) likened the approaches to the development of team skills in healthcare professionals to those used by sports

teams to improve their practice. Therefore, the concept of deliberate practice in teams, or team deliberate practice warranted further exploration.

#### **2.2.4.2 - Team deliberate practice**

Outside the healthcare arena a number of researchers had investigated TDP. Helsen et al. (1998) in their study of sportsmen engaged in international, national and provincial level team sports, found that both individual and TDP were key elements to the hours of accumulated practice. They used a retrospective analysis of the number of hours and the type of practice undertaken by both football players ( $n = 73$ ) and field hockey players ( $n = 51$ ) over their careers. They analysed the data using an ANOVA method and, found that both the international football players ( $F_{(2, 70)} = 63.32, p < .0001$ ) and international field hockey players ( $F_{(2, 48)} = 16.76, p < .0001$ ) engaged in more TDP than those players who were at a national or provincial level. Helsen et al. (1998) concluded that not only did the international players engage in individual DP over their careers, but to master their team sport, they also engaged in TDP.

Ward et al. (2007) also found that spending time in both team and individual practice provided an appropriate vehicle for skills progression. They recruited 203 male soccer players, aged between eight and eighteen years and asked, them to complete a questionnaire focused on their training activities. The data was analysed using a three-way ANOVA and, they found that the elite players started using team practice earlier than sub-elite players ( $F_{(8, 185)} = 53.53, p = .001$ ). They concluded that spending time in team and individual practice improved both the soccer players performance. Ericsson et al. (1993) also noted that during the early phases of an individual's development, establishing regular patterns of practice that, over time, were internalised and integrated into everyday practice, enhanced performance. In terms of nurse education,

the engagement of student nurses in TDP early in their careers could potentially improve their individual and team performance.

Baker et al. (2003) studied twenty-eight athletes (fifteen expert players and thirteen non-expert players) from three team sports (netball, basketball, and field hockey) and, used a retrospective structured interview technique to ascertain the hours of practice and type of practice they engaged in. Using a two-way ANOVA with repeated measures, they found a statistically significant interaction between the number of hours of practice undertaken by the expert group, which was greater, than that of the non-expert group ( $F_{(1, 24)} = 22.3, p < .05$ ). They concluded that the theory of DP should be broadened to include both the accumulation of task-specific practice and the learning that occurs through TDP. They emphasised that engaging in TDP could develop skills in decision-making, pattern recognition and spatial awareness. Lund et al. (2013b) also identified another key component of a players' expertise during team sports, which was the development of situational awareness, a key focus of teamwork training in healthcare (Dietz et al., 2014; Salas et al., 2008a; Salas et al., 2008b), and a pivotal component of human factors training (Flin et al., 2010; Lavoie et al., 2016; Leonard, 2004; Ostergaard et al., 2011). An understanding of human factors and effective team working had been identified as a vital component to patient safety (NHS Institute for Innovation and Improvement, 2010; Patient Safety First, 2009; WHO Patient Safety, 2009).

In a sports context, a situational awareness was defined by Endsley (2006, p. 633) as an "up-to-date understanding of the world around them". She also proposed that novices had poor information management strategies and, as a result, had limited ability to process information and, their cognitive processes often became overloaded when carrying out the necessary psychomotor and communication tasks further

compounding this. Those individuals who possessed greater expertise had more developed strategies of information processing (Endsley, 2006, p. 649) and, a critical factor to the development of a novice was the support of a coach (Lund et al., 2013b).

Lund et al. (2013b) further explored the concept of TDP or, shared DP, and undertook a study to identify and describe the relevant training situations used by a high performance handball team. Using a case study approach, they interviewed eighteen players and undertook a thematic analysis of the interviews and, identified four themes. The first was that DP in team sport was a shared activity. Second, both structured tactical training and match training were seen as DP, and third, concentration during DP facilitated team cognitive skills. Finally, they found that feedback and role modelling further mediated team cognitive skills. They felt that these points echoed the concept of individual DP and, concluded that their findings pointed to the value of viewing team sport as requiring shared DP (Lund et al., 2013b). Lund et al. (2013b) also, found that a coach played a pivotal role in defining the type of training undertaken and Helsen et al. (1998) observed that much of the practice in team sports was coach-determined. This could be likened to the SBE strategy I developed where the nurse educator undertook the role of the students coach (Woolley and Jarvis, 2007).

In sports, TDP had been effectively utilised as an educational strategy to improve team performance. Based on the principles of DP, this approach included well-defined learning objectives/tasks, set at an appropriate level, with opportunities for repetitive practice in teams that were coached by an expert who provided feedback on their performance (Helsen et al., 1998; Lund et al., 2013a). Therefore, engaging in TDP could have a number of potential benefits for healthcare practice and the delivery of both taskwork and teamwork training. As recommended by a number of authors, (Low

et al., 2018; Mcconaughey, 2008; Riggall and Smith, 2015), this concept warranted further exploration in relation to healthcare education.

#### **2.2.4.3 - Team deliberate practice in healthcare.**

In relation to healthcare, a number of studies demonstrated an improved performance using the DP framework and TDP principles. Sawyer et al. (2011) used a quantitative pre-test/post-test design to investigate the performance of paediatric residents following a neonatal resuscitation program (NRP). This included a number of SBE scenarios ( $n = 3$ ). Thirty paediatric residents enrolled in the study and were divided into fifteen teams of two. They had their performance measured using a previously validated tool, the Neonatal Resuscitation Performance (NRP) Evaluation tool. The results suggested that TDP using SBE appeared to be associated with a significant improvement in performance. Improvements were seen in their overall performance (pre-test 82.5% versus post-test 92.5%, mean difference 10% [95% CI, 1.5–18.5]  $p = 0.024$ ) and their positive-pressure ventilation technique (pre-test 73.3% versus. post-test 95.0%, mean difference 21.7% [95% CI, 0.8–42.5],  $p = 0.043$ ). The time to perform vascular access decreased by over one minute (pre-test 404 seconds versus post-test 343 seconds, mean difference 60.3 seconds [95% CI, 119.6 to 0.9];  $p = 0.047$ ) as did the time to administer the first intravenous medication (pre-test 452 seconds versus post-test 387 seconds, mean difference 64.9 seconds [95% CI, 112.4 to 17.5],  $p = 0.011$ ) (Sawyer et al., 2011). Sawyer et al. (2011) acknowledged that as they had used a quasi-experimental design the results only indicated an association between the effects of TDP using SBE and not a cause. They also did not include a control group which made it difficult to attribute causation to the intervention and, as the participant numbers were small, this limited the application of their findings (Boet, 2012; Seers and Critelton, 2001).

In another medically based study, Burden et al. (2014) used a quantitative pre-test/post-test design to investigate the performance of third-year internal medicine residents in simulated code scenarios. They assessed whether using SBE with DP to teach crisis resource management would lead to improved performance compared to the use of a lecture. Participants were randomly assigned to either an SBE with DP group or a lecture group. They created a crisis resource management using a Delphi technique and discussed its application but they did not report on its validity and reliability. Therefore their results would have to be viewed with caution. Nevertheless, the intervention resulted in significantly improved team communication and cardiopulmonary arrest management. Including diagnosis, were all participants in the intervention group correctly diagnosed the patient to 65% in the lecture group ( $p = .01$ ), and task assignment. 100% of the intervention group assigned tasks compared to 27% of the lecture group ( $p = .001$ ). They concluded that SBE with DP improved the communication and leadership skills of the participants.

In nursing, Abe et al. (2013) used a repeated scenario design to examine the effectiveness of SBE in improving the competency of cardiovascular critical care nurses. Focusing on both the taskwork and teamwork of team training their training programme consisted of a number of lectures followed by skills training and repeated SBE scenarios. Twenty-four qualified Japanese nurses participated in the study and were allocated to one of four groups. The participants, after the repeated scenario, assessed their own technical skills by scoring their performance on a rubric. They also completed a pre and post survey using a "Teamwork Activity Inventory in Nursing Scale" (TAINS) to assess their non-technical skills. Unfortunately, the authors only briefly discussed the reliability and validity of these tools and, as a result, made a critical appraisal of the results difficult. Nevertheless, they found a significant increase



in the teamwork scores for “attitudes of the superior” ( $p < .001$ ), “job satisfaction” ( $p = .01$ ), and “confidence as a team member” ( $p = .004$ ). They concluded that their educational approach enhanced the non-technical skills of their participants (Abe et al., 2013). In terms of the self-rated performance scores, all participants showed an increase after the second simulation. Due to issues with their methodological rigor, the application of the findings were limited.

Badowski and Oosterhouse (2017) used a quasi-experimental, comparison group pre-test/post-test design to assess the effect of their SBE approach on the knowledge, skills, and attitudes of 29 associate degree nursing students. Their SBE approach was a peer-coached, deliberate practice educational intervention that replicated a practice placement. It involved an unfolding scenario delivered over three weeks that focused on developing the head-to-toe assessment and medication administration skills of the students. The students were recruited and allocated to either an intervention group ( $n=14$ ) or a standard practice group ( $n=15$ ). Data was collected using a range of different tools: a skills checklist, a twenty-item multiple-choice exam and, the TeamSTEPPS™ Teamwork Attitude Questionnaire. Thus, it focused on both the taskwork and teamwork components of team training. However, the discussion regarding the validity and reliability of these was minimal and, as a result, raised the question of the applicability of their results. Although Badowski and Oosterhouse (2017) highlighted that the findings demonstrated improved knowledge and skill acquisition in both the intervention and control groups, these were not statistically significant. They, nevertheless, concluded that their approach was an innovative alternate to traditional clinical experience.

In another nursing study, Generoso et al. (2016), using a prospective, single-centre, mixed-methods quasi-experimental design, found statistically significant improvements in the performance of the nursing teams following their deliberate practice based SBE approach. This they termed “do-redo” training that focused on the first 5 minutes of an emergency situation. Using a convenience sample of 41 nursing teams (147 participants) they randomly assigned them to one of four pre-programmed SBE scenarios. Each scenario ran for 5-minutes and was followed by a debrief and immediately this the teams repeated the same scenario, which was once again followed by a debrief. They developed a checklist for each scenario to measure the teams’ performance, therefore their taskwork, but no detail regarding the development of this and its validity and reliability were discussed, therefore, the results would have to be interpreted with caution. These checklists were then used for both the first and second scenario to measure the performance of the teams. They noted improvements in initiating chest compressions ( $p = .018$ ), time to check blood glucose ( $p = .046$ ), and identification of heparin as a contributor to stroke ( $p = .043$ ). They concluded that this approach appeared effective in empowering nurses to manage emergency situations and recommended that future studies should be undertaken in this field.

Overall, there appeared to be a dearth of literature around the effectiveness of TDP in healthcare but, the discussion above highlighted the potential positive impact that both individual and TDP could have on the performance of learners. It was not just about how much a learner practiced, but how they actually undertook that practice (Ericsson, 2004) and, how they then established regular patterns of practice during their early career (Ericsson et al., 1993). The literature search identified a growing interest in nurse education in the use of DP and TDP as an educational methodology but most of the studies focused on individual skill development. The exception was the studies by Whyte and Cormier (2014), Badowski and Oosterhouse (2017), Generoso et al. (2016)

and, Abe et al. (2013) who offered a thought provoking glimpse into the potential use of DP and TDP in nurse education.

These studies were, however, undertaken outside the participant's normal curricula programme thus raising issues around their generalisability. The participants were also self-selecting volunteers, which further raised questions regarding the generalisability and application of the findings to a wider context. As Baker and Young (2014) advised, training should be smarter and focused on areas for development with a shrewd selection of activities and resources. In terms of resources and time, the studies did not address the constraints found in the delivery of SBE, DP and TDP. In addition, the studies used either a taskwork performance measure (Generoso et al., 2016) or a mixture of both taskwork and teamwork measures (Abe et al., 2013; Badowski and Oosterhouse, 2017) and did not offer a detailed rationale to their choice of tools. It was evident that there was a lack of literature pertaining to the use of DP or TDP integrated into an existing SBE curricula model and, a real educational setting. A gap in the literature, therefore, existed in this area of educational practice that warranted further study.

### **2.2.5 – Deliberate practice and debriefing.**

The literature review highlighted a clear need to develop and research the potential impact of individual DP and TDP on learners when it was combined with SBE. What was evident in the literature review was that there was a number of elements of DP, such as expert supervision and feedback that overlapped with effective debriefing. Therefore, the two approaches appeared to be congruent with each other. Eppich et al.

(2015) in a narrative review of DP and debriefing, introduced the concept of a “within-event” debriefing model. This model was entitled micro-debriefing. In this model, the participants followed a DP programme that allowed them opportunities to rehearse skills until they had achieved a set level of mastery. During the process, to support their development they received feedback, or debriefing, following each repetition. The authors felt that this maximised opportunities for learners to engage in DP with feedback and reflection and, as a result, this optimised their learning. They concluded by recommending that further studies should be undertaken to explore this concept further (Eppich et al., 2015).

Bosse et al. (2015) undertook a prospective RCT to explore the optimal feedback required in a single SBE with DP clinical skills session. In the study, following an initial instruction phase, medical students (N = 47) were randomised into either an experimental group (n = 23), who received feedback after each of their five SBE/DP repetitions (the high-frequency feedback group), or a control group (n = 24) who received feedback on just one occasion, after their fifth SBE/DP repetition (low-frequency feedback group, LFF group). Bosse et al. (2015) assessed the participant’s task-specific performance and their global procedural performance using expert-rated videotapes. The baseline data of the two groups did not differ and an ANOVA test revealed that there was no statistically significant difference between the groups ( $p < .147$ ). In an exploratory post-hoc analysis, they felt that there was a trend, after the training, towards superior performance of in the HFF group compared to LFF group ( $p < .093$ ). The smoothness of the procedure assessed as a global procedural performance was also superior in the HFF group compared to LFF group ( $p < .004$ ). However, they concluded that DP with both high and low frequency intermittent feedback, in a single SBE clinical skills session, resulted in an improvement in the

procedural skills of participants, as well as a smoother performance (Bosse et al., 2015). This study pointed to the efficacy of a within-event strategy that combined DP and debriefing.

### **2.2.6 – The development of “Simulation using Team Deliberate Practice” (Sim-TDP)**

However, both the study by Bosse et al. (2015) and the discussion paper by Eppich et al. (2015) once again focused on individual skill development and not the more complex holistic immersive scenarios that were used in the SBE programme I developed. To capitalise on the benefits identified in the literature review I developed an SBE model entitled “Simulation using Team Deliberate Practice” (Sim-TDP) (Appendix 1). The aim was to optimise participant performance, whilst at the same time maximising the use of available resources. The model incorporated the key elements of the DP framework (Ericsson, 2004) and provided the small teams of learners, after the initial scenario and debrief, an opportunity to “walk through” the scenario under the guidance of an expert facilitator who utilised the “within-event” approach (Bosse et al., 2015; Eppich et al., 2015). Following this, the scenario was then repeated and, finally, the learners attended another debrief so that they could reflect on their overall performance. Although a number of authors had implemented DP with reflective components, they had not integrated these into a curricula using a model such as Sim-TDP. As a key component to the integration of DP and TDP was the provision of timely and effective feedback, this component warranted further exploration into its impact and efficacy.

### **2.2.7 – The research question.**

As Kneebone et al. (2004) recommended, SBE should be fully integrated into healthcare education to provide a safe environment where learners could repeatedly practice their skills without endangering patients. This integration should be undertaken in such a way that it was delivered at the right time within a curricula that was both effective and appropriate to the needs of students (Alinier, 2007). It was evident that there was a lack of literature pertaining to the use of DP and, in particular, TDP in nurse education and how it could be integrated into a real educational setting and an existing SBE nursing curricula. In sports, TDP had been effectively utilised as an educational strategy to improve team performance. Therefore, engaging in TDP offered a number of potential benefits for healthcare practice and in the delivery of both taskwork and teamwork training. Although a very small number of nursing studies gave an insight into the potential use of DP and TDP in nurse education there were a number of issues around their generalisability and application. The progressive use of DP in a real setting, such as a nursing curricula or, the use of TDP in nursing SBE, had not been explored in the literature. Therefore, the literature search identified gaps in terms of the effect of a TDP intervention on the performance of a team of nursing students and, in keeping with the principles of DP, how this impacted on performance over time. This gap also extended to the knowledge and confidence of nursing students.

Thus, the overall aim of the research and initial research question, based on the identified gaps, was to compare the effect of a TDP based SBE intervention, Sim-TDP, with those of a traditional SBE delivery, within a structured SBE strategy, on the

performance, knowledge, and self-efficacy of second year adult nursing students. In keeping with the paradigm a number of hypotheses would be proposed that would focus on comparing the effects of Sim-TDP over time and the effects that occurred during each phase. Combined, these would explore whether or not providing opportunities to rehearse skills using TDP would enhance the performance, knowledge, and self-efficacy of participants, whilst maximising the available resources compared to a traditional SBE approach. In addition, to address the issues around recognising the deterioration in patients the impact of Sim-TDP on time on task would be compared to the traditional SBE approach. This thesis describes the development and implementation of the study to answer the research question.

## **2.3 – Chapter summary.**

This chapter presented a literature review that explored the concept of DP. A number of key educational elements were identified that underpinned the DP framework developed by Ericsson (2004). In a healthcare context, the review identified that there had been a great deal of interest within the SBE literature, and a number of studies and meta-analyses had found that an SBE incorporating DP was superior to other educational methods. In the nursing literature, a smaller number of studies had been undertaken but, they nevertheless offered compelling evidence to the benefits of using DP in nurse education.

These studies had, however, been undertaken in “laboratory style” settings and not within a normal curricula programme, which questions their generalisability and application to a wider context. Many of the studies also focused on individual skill

development rather than the more holistic nature of nursing practice. The literature review identified a growing interest in the SBE literature regarding the use of DP and debriefing. Especially as a number of the elements of DP overlapped with those of effective debriefing but, there was no evidence to support this approach. In addition, the use of TDP was highlighted as a potential approach to meet the challenge of delivering effective education to large student cohorts with finite resources. There was, however, a dearth of literature available on the application of this concept to nurse education. A gap in the nurse educational literature, therefore, existed on the use of DP, TDP and debriefing. In addition, there were no evidence-based frameworks or models to guide the integration of SBE with TDP and debriefing into a curricula. Therefore, following the review I developed an SBE model entitled Simulation using team deliberate practice (Sim-TDP) (Appendix 1). A model aimed at capitalising on the benefits of TDP and debriefing to ensure optimal learning, whilst maximising the use of available resources.

The aim of this thesis was, therefore, to compare the effect of the Sim-TDP model, against a traditional SBE approach, within a structured SBE programme, set within a real curriculum, on the performance, knowledge and confidence of nursing students. The next chapter explores the research strategy adopted to address this aim.



# Chapter Three: Methodology

## 3.1 – Chapter overview

The previous chapter provided a detailed three-stage review of the literature pertaining to the concept of DP and TDP and, a gap in the nursing literature was identified around their use. It also gave the background to the development of the Sim-TDP model and presented the aim of this thesis: to compare the effects of Sim-TDP as a learning and teaching approach against that of a more traditional SBE approach. This chapter examines the chosen research methodology and its underpinning philosophy. In doing so, it explores the ontology and epistemology of the various research paradigms, and offers an overview and rationale for the quasi-experimental pre-test/post-test design adopted. This approach enabled the manipulation of the independent variable, Sim-TDP, so that its effects on the dependent variables of the participant's performance, knowledge, and confidence/self-efficacy could be observed, measured and compared to a traditional SBE approach.

## 3.2 - Research methodology

The choice of the research methodology was a challenge, but the exploration of my own values and past experiences enabled me to construct a personal philosophy that guided the research process (Harper and Hartman, 1997, p. 46) and, the subsequent

approach I adopted. Firstly, I began by exploring the various research approaches. Polit and Beck (2010, p. 14) identified two main approaches to undertaking research: quantitative and qualitative; both based on their own philosophical perspectives (Harper and Hartman, 1997, p. 19; Punch and Oancea, 2014, p. 16). As the nature of the research question itself determines whether a quantitative or qualitative approach should be used (Boet, 2012) these approaches were explored in the context of the aim of the research. This was to compare the effect of the Sim-TDP model, against a traditional SBE approach, within a structured SBE programme, set in a real curriculum, on the performance, knowledge and confidence/self-efficacy of adult branch nursing students.

### **3.2.1 - Qualitative methodology**

Based on a naturalistic paradigm qualitative research aims to interpret and create meaning out of the subjective reality of humans, whilst taking into account the whole life context of a person (Polit and Beck, 2010, p. 18). Ontologically this paradigm acknowledges a mentally constructed, socially and culturally based reality that has the potential for multiple interpretations (Harper and Hartman, 1997, p. 30). Therefore, epistemologically any knowledge generated has to be constructed in a social context with the researcher interacting with those who are being studied with theory being generated from the data collected (Harper and Hartman, 1997, p. 30). As a result, objectivity and neutrality are impossible to achieve due to the fact that the researcher has not been able to divorce themselves from the phenomenon under study (Todres and Holloway, 2010, p. 179). Agreeing with Green and Holloway (1997), I felt that this paradigm had a humanistic ideology that, as a nurse, with my own discrete professional values, I identified with and felt comfortable using. Additionally, as a nurse educator and researcher, I felt that this methodology offered a route forward to

explore the perceptions and experiences of the participants undertaking Sim-TDP in comparison to a traditional SBE approach.

### **3.2.2 - Quantitative methodology**

In contrast, Seers and Critelton (2001) centred the quantitative research approach within the positivist paradigm since it has an objective reality where phenomena can be observed and measured. This methodology has its roots in scientific enquiry that aim to test theory and hypotheses (Topping, 2010, p. 130). Research of this kind is frequently described as being positivist or empiricist. (Bryman, 1984). Its ontology rests in an objective reality where phenomena are driven by natural laws (Polit and Beck, 2010, p. 15), and its subsequent epistemology recognises knowledge as being grounded in science and, therefore, can be observed or measured (Maltby, 2010, p. 25). As a result, it has to be conducted in a systematic and controlled manner (Hagan, 2014) with the collection of numerical data being subjected to statistical analysis (Polit and Beck, 2010, p. 7). A well designed and executed quantitative study, therefore, contributes to the theoretical understanding of the topic under study (Nelson et al., 2010, p. 199). An aim that appeared to be more consistent with the research question but one that was at odds with my own discrete professional values as a nurse educator and researcher. As noted by (Bryman, 1984) the choice of a particular epistemological base leads to a preference for a particular method on the grounds of its greater appropriateness. Therefore, before adopting an approach, I felt that it was vital to explore, from an epistemological perspective, the study variables with the aim of guiding the methodological approach in the context of the aim of the research.

### **3.2.3 – Epistemological discussion**

As Boet et al. (2012) noted, there has been a shift in healthcare educational research from studies that just focused on the impact of educational interventions on learners' satisfaction and attitudes to those that investigated the impact of educational interventions on learning. A point reinforced by the DH (2011) who recommended that SBE should be evidence based and educationally coherent. Further, as van Merriënboer and Sweller (2005) argued, there was a need for experimental methods that could be used to develop sound instructional theories capable of making real differences to educational practice. Polit and Beck (2010, p. 64) defined a theory as a systematic, abstract explanation of an aspect of reality where concepts were knitted together into a coherent system to describe or explain some aspect of the world. Theory and research are intrinsically linked with theory informing research and vice versa (Maltby, 2010, p. 13). In qualitative studies, theory is often the product of the research, whilst in quantitative studies the researcher often starts with a theory and then uses deductive reasoning to make predictions about a phenomena (Polit and Beck, 2010, p. 64). This latter description would appear to fit with the overall aim of my research and initial research question, based on the identified gaps, was to compare the effect of a TDP based SBE intervention, Sim-TDP, with those of a traditional SBE delivery, within a structured SBE strategy, on the performance, knowledge, and self-efficacy of second year adult nursing students. This also resonated with my personal aim of developing an evidence based SBE approach that, through observation and measurement, would make a real difference to the delivery of SBE and, as such, a quantitative approach appeared more congruent. It was this personal aim, of optimising student performance that led to the development of the Sim-TDP model, the independent variable of the study.

### **3.2.3.1 - Independent variable**

As the literature review highlighted, SBE was a theory rich learning and teaching methodology and, that the DP and TDP theoretical frameworks offered a possible approach to optimise student performance. To achieve this I developed an innovative approach to SBE delivery entitled Sim-TDP, the independent variable for this study. This combined SBE with both the DP framework (Ericsson, 2004) and TDP approach and encompassed the classic three stages of SBE; the pre-brief, clinical scenario and debrief (Lioce et al., 2015) followed by a “walk through” of the scenario facilitated by a member of the academic team. Once completed, the participants then repeated the same scenario and concluded by undertaking a final debrief.

Furthermore, as The National Institute for Health and Clinical Excellence (2007) and The National Patient Safety Agency (2007) recommended that all healthcare staff should have the education and training to make sure that they have the competencies to monitor, measure, interpret and respond promptly to the deterioration in a patient’s condition this, a stance echoed by the NMC (Nursing and Midwifery Council, 2010), this would have to be incorporated into the SBE activity to meet professional requirements. However, the literature review highlighted that SBE was a complex learning and teaching methodology designed to represent a clinical situation that participants may encounter during their clinical practice for example, a patient suffering from chest pain. Therefore, they incorporated the salient signs and symptoms that patients would present with into their design, such as a high respiratory rate. They also needed to incorporate a systematic assessment in recognising the deteriorating patient, for example the “ABCDE” (**A**irway, **B**reathing, **C**irculation, **D**isability and **E**xposure) (The Resuscitation Council (UK), 2015a). Together with the “SBAR” mnemonic (**S**ituation, **B**ackground, **A**ssessment and **R**ecommendation) to be used as a structured handover tool (The National Patient Safety Agency, 2007). To explore the effect of Sim-TDP and compare it a traditional SBE approach, meant that I would need to reduce the

complexity of the approach into smaller component parts that could be compared. This reductionist approach fitted more with a quantitative approach (Topping, 2010, p. 130).

Thus, my personal aim of developing an evidence based SBE approach that would make a real difference to the delivery of SBE and optimised student performance.

Together with the need to reduce the complexity of SBE led to a shift away from a qualitative to a more quantitative approach. To further explore this stance I began to focus on potential dependant variables and, in the process, developed a construct for each one.

### **3.2.3.2 – Dependent variable**

#### **3.2.3.2.1 – Performance**

As concerns had been raised regarding the quality and safety of healthcare provision and the competence of healthcare practitioners (Oermann, 2011; Wilford and Doyle, 2006) I felt it was imperative to explore this in terms of the research question. The aim of the pre-registration nursing programme was to equip nursing students with the necessary competencies to ensure that they were competent at the point of registration (NMC, 2010 p: 11). These competencies were set within a competency framework contained in the NMC's (2010) Standards for Pre-Registration Nursing Education. The use of the terms competency and competence have, however, led to some confusion about what they actually mean and, how they apply to professional practice (Lurie, 2012; Rethans et al., 2002; Teodorescu, 2006). Competency has been described as the skills, knowledge, attributes, and behaviours required for successful performance in

a specific role (Eraut, 1998; Fastre et al., 2010; Teodorescu, 2006). Eraut (1998) described these as an individual's professional capability and, elaborated further by maintaining that they were everything a person thinks or does relevant to their professional role. A description congruent with the standards for professional nursing practice identified within the NMC's professional standards of practice and behaviour for nurses and midwives (NMC, 2015), and their standards for pre-registration nursing education (NMC, 2010). The use of SBE has been identified as a potential method of enhancing professional capability. In a qualitative study by Pollock and Biles (2016) students felt that SBE gave them an opportunity to test their capabilities in a safe learning environment. However, Teodorescu (2006) and Lurie (2012) noted that a major problem with this view of competency was that it was too broad and, as a result, they felt that it did not link to actual day-to-day practice and, therefore, it could not be directly observed or measured.

Conversely, the term competence focuses on measurable, specific, and objective goals that practitioners need to achieve, at an expected standard, within an occupation (Andreatta and Lori, 2014, p. 33; Eraut, 1998; Teodorescu, 2006). As this was observable, the evidence for competence attainment could be taken from an individual's performance and, therefore, reflected and measured what they do in their professional practice (Andreatta and Lori, 2014; Eraut, 1998; Fastre et al., 2010, p. 33; While, 1994). Lurie (2012) agreed, and believed that it was more appropriate to measure competence in terms of performance rather than competency in its broader sense. This resonated with me as it aimed at defining measurement in terms of what could be measured and what counted as measurement (Colliver et al., 2012). This view further strengthened the case for a quantitative approach, one that necessitated the development of a tool to observe and measure performance as an independent

variable. It also provided a working definition of performance a vital step in developing an instrument to measure them (Polit and Beck, 2010, p. 67).

Fastre et al. (2010) referred to this approach as performance-based assessment and highlighted that when performance indicators were set as criteria, they offered a step-by-step process that led to a desired level of performance. This view, therefore, offered a construct that I could use to guide the measurement of the participants performance, whilst enabling this to be tracked and, as this was being supported by expert facilitators this could lead to improved performance and, a decrease in the variability in practice standards (Teodorescu, 2006). Fastre et al. (2010) emphasised the importance of students receiving feedback on their performance during the early stages of their development and, because of the observable nature of performance-based criteria, this would further enhance learning. This view was also in line with Ericsson (2004) DP framework. Therefore, the performance-based criteria approach provided a viable framework to assess the participant's performance in the study. This method would also enable a comparison to be made between Sim-TDP and the traditional SBE, in line with the research question, and pointed towards a more quantitative approach being adopted. As this meant that the participants' performance could potentially be observed and measured, I could not adopt the broader view of competency and, therefore, a more qualitative approach to my study. However, as the participants in my study would undertaking the SBE activities in small teams I needed to explore whether a quantitative methodology would be appropriate approach to adopt.

#### **3.2.3.2.1.1 – Team training and performance**

As described earlier, team training has a taskwork and team work track (Glickman et al., 1987; Salas et al., 2008b), which should be developed separately in the early



stages of a team's training so that a solid foundation has been set before a team's training progresses and they are combined (Glickman et al., 1987; Mathieu and Rapp, 2009). A number of authors (Glickman et al., 1987; Rosen et al., 2008; Tannenbaum and Cerasoli, 2013) agreed and felt that it was important to distinguish between individual taskwork and teamwork competencies as they felt that they were distinct and, as a result, should be measured separately. This approach, measuring the two tracks separately, offered a plausible method of measuring the performance of the participants in my study. As identified by (Salas et al., 2008b) the quality and/or efficiency of a team's performance could be measured against predetermined goals or standards, which need to be specific to the learning objectives being taught (Rosen et al., 2008). In relation to my study, these would be set around the early recognition of a deteriorating patient and include relevant physiological, pathophysiological and environmental cues that a patient would present with. As task focused team training enabled members of the team to become more aware of each other whilst practicing their competencies (Salas et al., 2008b) a focus on the taskwork track would appear appropriate. This approach would also fit with the recommendation from Ericsson (2004) regarding the evaluation of DP. He felt that the first steps should be the construction of a list of representative tasks that captured the performance in a consistent and reproducible manner. The identification of salient cues to aid decision making relates to the theory of probabilistic functionalism proposed by Brunswik (1955a).

Brunswik (1955a) developed this theory to study how humans interacted with their environment and how they interpreted relevant cues. He was a psychologist who moved away from the traditional experimental designs of the time that were often based in controlled settings and not in the real world. He developed these concepts to

support how human interact with their environments. Brunswik (1955a) posited that the environments that we come into contact with were semi-erratic and uncertain or, as he termed them, probabilistic in nature and forwarded that in order to function we must select those environmental cues that are most useful. Kirlik (2010) related this theory to decision making in healthcare practice, which he felt was nearly always inferential and was made on the basis of a combination of cues each of which was only probabilistically related to the true, underlying condition or diagnosis. A study by Nadler et al. (2011) further related this to healthcare. They found that the accuracy of an individual team member's decision making depended not only depended on their individual skills, or taskwork, and ability to recognise salient cues, but also on how effectively these cues were communicated between all members of the team. The team's ability to recognise these changes necessitates the them being able to detect cues in the environment (Rosen et al., 2011). A point echoed by Baker et al. (2006) who felt that the tasks performed by one member of the team were dependent on the tasks performed by other members of the team and that the performance of these tasks had to be coordinated among team members for effective team performance.

This may, therefore, be a good indicator for the effectiveness of team coordination (Nadler et al., 2011) and, as a result, a vital component of SBE scenarios and not only the taskwork components of team training but also reflect the coordination component of teamwork. As, Pugh et al. (2014) noted, many of the existing team assessments largely focused on common teamwork behaviours and not the elements of taskwork and, as a result, they argued that taskwork elements should be included as they were important variables when evaluating team performance. Rosen et al. (2011) believed that when a team's performance was being measured in an environment where some control over environmental cues was possible the use of an event-based measurement

tool was feasible. Schmutz and Manser (2013) agreed, finding in their systematic review found that during SBE activities performance checklists were preferable as they took into account the most important actions for a specific treatment. Thus, experimental design must ensure that the cases or situations presented to participants are similar to those forming the basis of experientially acquired knowledge (Kirlik, 2010). As SBE was a measurable, reproducible and controllable learning and teaching strategy and that patient simulators were able to reproduce many human physiological responses (Bradley, 2006; Devita, 2009; Harder, 2009; Rosen, 2008) an event-based measurement tool appeared to an appropriate option. This links further to the probabilistic functionalism theory developed by Brunswik (1955a) and, in particular, the concept of representative design. He theorised that, experiments should have a representative design in which participants are exposed to situations that represent the range and distribution of situations and cues in their natural environment (Nadler et al., 2010). In my study this would represent what the participants would encounter in a hospital setting and, in particular, those deteriorating patient cues that they would come across. Therefore, during my study the participant's would need to assess using the ABCDE framework (The Resuscitation Council (UK), 2015a) and collate the representative cues to identify deterioration such as increased respiratory rate, tachycardia and an audible wheeze and report these using the SBAR mnemonic (The National Patient Safety Agency, 2007). These would form the basis of an event-based or performance checklist that could be used to follow the progress of the participant's over time.

#### **3.2.3.2.1.2 – Performance and learning curves**

Additionally, as my study follows participants over one year of their second year adult nursing programme I would need to capture their performance over time. As Lammers et al. (2008) noted, when the acquisition of skills occurs at a regular rate and, when plotted against time, a learning curve can be produced. This curve can be plotted mathematically thus providing a mathematical representation of the learning process that takes place as task repetition occurs and, as a result, it can demonstrate a learners actual performance over time (Anzanello and Fogliatto, 2011; Glocka et al., 2018). This provided a working definition of learning curves for my study. Classically, as a learner moves up the learning curve rapidly but, with repeated practice, the rate of learning begins to slow resulting in less learning and, the amount of performance improvement gained decreases (Pusic et al., 2011). The benefits of utilizing learning curves include assessment of skills over time (Pusic et al., 2012), identification of variables that can accelerate the learning process that will lead to cost-effective training, and the identification of learner developmental curves that can be used to map a learners progress (Manuel-Palazuelos et al., 2016).

This approach and the measurement of performance over time would fit well with the research aim and added further weight to adopting a quantitative approach. Especially as this approach has been used effectively in industrial settings (Glocka et al., 2018; Jaber and Bonney, 1996) and, in healthcare, in such diverse clinical settings as radiography (Pusic et al., 2011), critical care (Prat et al., 2016) and laparoscopic surgery (Herrell and Smith, 2005; Manuel-Palazuelos et al., 2016). In medical students, Jiang et al. (2011) were able to assess the learning curves of the students undertaking an SBE thoracentesis training programme. This included five initial thoracentesis sessions followed by two reassessment sessions at six months and 12 months. They found that the programme significantly improved the student's performance ( $p < 0.05$ ) compared to medical trainees who had not received the training. They also found that

the participants reached a plateau in their learning after four sessions leading them to conclude that the full effect of the programme was achieved at this point and any further training would not lead to improvements in competence.

Perry (2011) identified confidence as being an integral factor in the development of a practitioner's competency, as it had a direct effect on their performance and, it was only when a nursing student had confidence in their own ability that they were able to shift their focus to the needs of their patients (Leigh, 2008). As I now had the performance framework, the next stage was to explore the concept of confidence as a potential dependant variable.

### **3.2.3.3 – Confidence/self-efficacy**

Andreatta and Lori (2014, p. 27) identified two primary factors that influenced behaviour in practice: the student's confidence in their ability to perform what was required and, competence to accurately perform what was required. Confidence was, therefore, essential to the provision of good patient care. This was acknowledged by the NMC (2015, p. 9) in their Code of Professional Standards of Practice and Behaviour, which stated that all qualified nurses and midwives should "support students' and colleagues' learning to help them develop their professional competence and confidence".

Andreatta and Lori (2014, p. 28) defined confidence as "...a learner's conscious and subconscious belief about their ability to successfully perform what was required to achieve a favourable outcome in a clinical context".

A number of authors (Bambini et al., 2009 ; Bricker and Pardee, 2011; Burns et al., 2010; Hope et al., 2011; Jeffries and Rizzolo, 2006; Kaddoura, 2010; Mould et al.,

2011), have found that SBE had a positive impact on the confidence of learners. An outcome further reinforced by a systematic review by Cant and Cooper (2010) who also found a positive effect. Conversely, a number of studies found no significant difference in the confidence of students who had participated in SBE to those who had not (Alinier et al., 2006a; Alinier et al., 2004; Liaw et al., 2012; Pike and O'Donnell, 2010; Reinhardt et al., 2012). A number of systematic reviews (Weaver, 2011b; Yuan et al., 2012) also concurred and concluded that there was insufficient evidence to support the notion that SBE enhanced a student's confidence.

Despite the dissonance in the literature, Hecimovich and Volet (2011) reasoned that the development of a learner's confidence was vital to their acquisition of clinical skills. A point echoed by Andreatta and Lori (2014, p. 32) who explored this further and developed the concept of a confidence continuum. This they reasoned commenced with a novice practitioner, who did not possess much confidence, through to an expert practitioner who had developed confidence in their abilities. During this process, learners needed to have opportunities to practice their skills, whilst receiving informative feedback on how they had performed (Hecimovich and Volet, 2011). Hecimovich and Volet (2011) continued that for performance feedback to be effective, it must direct attention to the corrective changes that a learner needed to make and, be delivered in such a way that it built confidence in their capabilities. This was congruent with the DP framework and, in particular, the elements of the rehearsal of skills, performance feedback and the setting of new goals (Ericsson, 2004). It was also consistent with the debriefing with good judgement approach (Rudolph et al., 2006). This view lent itself to a more qualitative approach where the perceptions of the participants' levels of confidence could be explored.

Bambini et al. (2009 ) postulated that SBE promoted a student's self-confidence due to an increase in their sense of self-efficacy. Perry (2011) agreed, noting that self-confidence was a person's belief that he or she could succeed; this was task specific and related to a person's self-efficacy. Bandura (1997, p. 3) defined self-efficacy as a person's belief in their capability to execute a course of action that was required to produce a given attainment. A strong sense of efficacy enhanced accomplishment and contributed to a learner's intellectual performance (Bandura, 1993; 1997, p. 214). Thus, confidence, in terms of self-efficacy, was central to learning (Andreatta and Lori, 2014, p. 28; Perry, 2011; Roberts and Johnson, 2009). It was, therefore, judicious to explore the effect of the independent variable, Sim-TDP, on the dependent variable, the participant's self-efficacy compared to a traditional SBE approach. Using the definition of self-efficacy by Bandura (1997, p. 3) to provide a working definition for the study the research question and hypotheses were amended to include the participant's self-efficacy in relation to specific skills and not their overall confidence. Thus, the study would aim at capturing the participants' reports of their perceived self-efficacy related to specific skills and not the theoretical construct of confidence. This could be achieved by using a questionnaire technique (Göb et al., 2007; Griffiths and Rafferty, 2010, p. 412; Polit and Beck, 2010, p. 346), which, through the assignment of a numeric score that can be measured at an ordinal level (Jones and Rattray, 2010, p. 376). This method lends itself to a more quantitative approach as it would enable a comparison to be made between Sim-TDP and the traditional SBE in line with the research question.

In addition, the ability to underpin practice with theoretical knowledge and understanding has been recognised as a key component of a nurses overall competency (Eraut, 1998; Fastre et al., 2010; Teodorescu, 2006). Therefore, it was vital to ascertain whether the participants the knowledge to practice safely so, at this

point, I progressed to exploring the concept of knowledge acquisition as a potential dependent variable.

#### **3.2.3.2.3 - Knowledge**

According to a number of authors (Duan, 2006; Groom et al., 2014) learning across the cognitive, psychomotor and affective domains of learning could be achieved through the use of SBE. Subsequently, a number of studies (Burns et al., 2010; Gates et al., 2012; Laschinger et al., 2008b; Liaw et al., 2012) had reported gains in knowledge when SBE was used. As Leigh (2008) and Pollock and Biles (2016) purported, SBE could also be used as a vehicle to translate classroom knowledge to the practice setting, whilst providing a safe learning environment for learners. Hope et al. (2011) concurred, in their study they found that the students reported that SBE had enabled them to transfer the knowledge they had gained into their practice, therefore developing their knowledge through the synthesis of experience, theory and practice (Prowse, 1996). Thus developing experiential knowledge (Dale, 1994). This integration of knowledge, encourages the learner to use theory to understand practice (Prowse, 1996) and, when supported through the process of scaffolding (Wood et al., 1976), moved them from their current level of knowledge through their zone of proximal development to their knowledge in waiting (Vygotsky and Cole, 1978).

A consistent theme within the educational literature appeared to be the categorisation of knowledge into two types. Korthagen and Kessels (1999) proposed that professional activities contained two forms of knowledge: epistemic knowledge (formal knowledge) and phronesis (practical knowledge). Spouse (2001) used the terms knowledge in



waiting (epistemic) and knowledge in use (phronesis) to describe the two types. The notion of two categories of knowledge was also evident in Miller's (1990) four stage framework for the assessment of clinical skills. Both the first two tiers of the actual knowledge of a skill ("knows") and the ability to interpret and analyse this knowledge in a professional context ("knows how") could be learned from literature and lectures (Miller, 1990). These had to be achieved before moving on to the top two tiers of performance ("shows how") and application to healthcare practice ("does") (Miller, 1990). The first two tiers were therefore, an essential pre-requisite before undertaking an immersive SBE scenario (Alinier, 2007; Pollock and Biles, 2016). Regardless of terminology, a key underlying message was the application of theoretical knowledge into practical knowledge, which was best viewed as a process (Anderson et al., 2008).

Based on this discussion, in the context of the study, a working definition of knowledge was proposed, which was the process of applying theoretical knowledge into practical knowledge (Anderson et al., 2008; Korthagen and Kessels, 1999; Spouse, 2001). I therefore, deemed it prudent to compare the effect of the independent variable on the participant's knowledge and, their ability to apply it to a realistic clinical scenario.

Bloom's taxonomy provided such a process as it offered a framework that incorporated the application of theoretical knowledge into a series of hierarchical levels of learning. In the cognitive domain, students progressed through the levels of remembering, understanding, applying, analysing, evaluating and creating (Anderson et al., 2001; Bloom, 1956). In terms of SBE, setting knowledge-based learning outcomes at the level of application was recommended in a number of SBE standards (INACSL Standards Committee, 2016b; Lioce et al., 2015; Lioce et al., 2013; Sando et al., 2013). Thus, the study would aim at capturing the participants' specific knowledge of the scenario at the application level and not the theoretical construct of knowledge. This

again could be achieved by using a questionnaire technique (Göb et al., 2007; Griffiths and Rafferty, 2010, p. 412; Polit and Beck, 2010, p. 346), such as, a multiple-choice questionnaire (MCQ) Daniels et al. (2010) which through the assignment of a numeric score could be measured (Jones and Rattray, 2010, p. 376). This method would enable a comparison to be made between Sim-TDP and the traditional SBE in line with the research question and again would point towards a more quantitative approach being adopted.

#### **3.2.3.2.4 – Epistemological discussion summary**

In summary, the discussion above, related to the study variables, appeared to support the adoption of a quantitative approach as this methodology was more consistent with the research question. As stated by Bryman (1984) the research must reflect the appropriate epistemological framework. In exploring the independent and dependent variables I found that they aligned to an epistemology position that recognises knowledge as being grounded in science and that can be observed or measured (Maltby, 2010, p. 25), hence a quantitative approach. This would also mean that I adopted an objective independent stance detached from the participants (Harper and Hartman, 1997, p. 24; Polit and Beck, 2010, p. 15). Moreover, the numbers of appropriately trained staff, facilities and specialised equipment needed for the delivery of effective SBE has been recognised as placing a huge burden on the finite resources available in an organisation (Fritz et al., 2008). As a result, key stakeholders had requested validation of the effectiveness of SBE as an educational approach (Lammers et al., 2008). Consequently, the challenge for SBE educators has been to develop a robust evidence base that demonstrates the efficacy of this method (DH, 2011; McGaghie, 2008; McGaghie et al., 2010; Okuda et al., 2009; Parker, 2009;

Prion and Adamson, 2012). Using a quantitative approach would, therefore, meet the need to provide the evidence, for or against, the efficacy of SBE as a learning and teaching methodology. This also resonated with my personal aim of developing an evidence based SBE approach that, through observation and measurement, would demonstrate that it optimised student performance and made a real difference to the delivery of SBE.

Additionally, as Polit and Beck (2010, p. 36) argued, the use of evidence based practice may be a major paradigm shift for healthcare educators, but it provides a means of improving health care quality within a cost constrained environment. Topping (2010, p. 129) also observed the shift in nursing educational research from a predominately qualitative approach to a more quantitative methodology. One factor that has fuelled this move was the need to ensure that students were competent at the point of registration (NMC, 2010). The subsequent emphasis on outcome measures has led to an increasing use of quantitative methods (Topping, 2010, p. 138). This further supports my choice of a quantitative methodology. Furthermore, both Ericsson (2007) and Clapper and Kardong-Edgren (2011) argued that nurse education would benefit from implementing DP to improve not only the performance of nurses, but also the efficacy of nurse education. As Kennedy (2011) identified, high quality educational interventions are required to ensure peak levels of human performance during any situation. In exploring the effects of DP and TDP using SBE within nurse education this would add to the development, understanding and evidence base for the use of DP as an educational intervention.

The collective weight of these discussions led me to shift my stance, philosophically, from a qualitative approach to the adoption of a quantitative approach to compare the impact of Sim-TDP, against a traditional SBE approach, through specific hypotheses

testing (Boet et al., 2012) to provide the evidence base for the effectiveness of this approach.

### **3.3 - Chapter summary**

This chapter provided an overview of the processes adopted in choosing the research methodology. It explored the ontology and epistemology of the chosen design and provided a rationale for its choice. This would enable me to manipulate the independent variable, Sim-TDP, so that its effects on the dependent variables of participants' performance, knowledge, and confidence/self-efficacy could be observed and measured. The next chapter discusses the process adopted to achieve this.

# Chapter Four: The research process

## 4.1 – Chapter overview

The aim of my study was to investigate the effect of Sim-TDP, compared to a traditional SBE approach, on the performance, knowledge, and confidence/self-efficacy of second year adult nursing students. The previous chapter provided a rationale for my choice of a quantitative methodology. As I used a quasi-experimental longitudinal pre-test/post-test design a number of aspects had to be considered to ensure the rigour of the study. This chapter builds on this by outlining the various stages in the research process I adopted. It starts by discussing the actual method adopted: a quasi-experimental longitudinal pre-test/post-test designs before moving on to the issues around and sampling and the design of the study where I explore and operationalise the independent and dependent variables, which led me to posit the research question and hypotheses. Finally, the chapter covers other methodological considerations such as the ethical underpinnings of the research.

## 4.2 – Study method, quasi-experimental

As a methodology underpins how a study progresses; namely, its assumptions, principles and procedures ([Boet et al., 2012](#)), having chosen a quantitative approach I began to explore the quantitative approach in more depth. Quantitative studies have been broadly categorised into either experimental or observational methods ([Polit and](#)

Beck, 2010, p. 71). The key features of an experimental method have been identified as the manipulation of an intervention and the use of a controlled group (Botti and Endacott, 2008; Seers and Critelton, 2001). Manipulation has been described as the conscious alteration of an independent variable during a study and, the observation of its effect on a dependent variable (Bettany-Saltikov and Whittaker, 2014; Botti and Endacott, 2008; Polit and Beck, 2010, p. 226). The inclusion of a control group means that a comparison could be made between the intervention or, experimental group, and the non-intervention, or control group (Polit and Beck, 2010, p. 226). This method would certainly lend itself to my study and comparing Sim-TDP with traditional SBE, however, other approaches would need to be explored to ensure I adopted the most appropriate method for my study.

One possible method would be using an action research approach, which has proven popular with educationalists especially as it combines action with research (Cohen et al., 2011, p. 344). It has been described as a process whereby a researcher investigates a problem through a planned cycle of interventions followed by an evaluation of their effects with the ultimate aim of solving the problem and increasing knowledge (Maltby, 2010, p. 65; Smith, 1997). This approach certainly was appealing as it would have enabled me to follow the students over time and following each stage of the evaluation cycle I could reflect and make changes to the Sim-TDP intervention, thus, enhancing its design. As action research could also be collaborative through participatory action research (Cohen et al., 2011, p. 344), the students participating in the study could also be actively involved. However, when I explored this in the context of my research question this approach did appear as relevant. As I wanted to compare the effects of Sim-TDP to traditional SBE over time, a key component of DP, I felt that I could not make any changes to the intervention over the course of the study as this

would affect internal validity. Using the participants would also affect internal validity as it could lead to cross contamination between the intervention and comparison groups. Therefore, this method was not adopted.

Another approach that also appealed was that of using mixed methods and including an experimental as well as a qualitative method such as phenomenology. The latter would enable me to investigate a phenomena, traditional SBE and Sim-TDP, through the lived experiences of the participants (Polit and Beck, 2010, p. 267). This approach would mean that I maintained the ability to compare, through observation and measurement, Sim-TDP with traditional SBE through an experimental method, whilst at the same time investigating the perceptions of the participants. This could enable me to triangulate the results to gain a better understanding of the effects of Sim-TDP and enhance validity of the results (Polit and Beck, 2010, p. 285). A very appealing prospect. To this end during the pilot phase I initially I tested the feasibility of this approach but, unfortunately, the process proved impractical. Although, I had planned to undertake a series of focus groups with participants from both the comparison and intervention groups and run these separately I ran into a number of problems. The first was with scheduling the focus groups around the participants' timetables so that they did not negatively impact on their time and academic workload. Once planned and the participants invited I found that only one or two attended, which was below the recommend five to ten people to gain any meaningful data (Maltby, 2010, p. 122; Polit and Beck, 2010, p. 341). Moreover, following the same students over the course of the study would be extremely difficult. I therefore, for pragmatic reasons, adopted the experimental approach only.

In keeping with the experimental method, randomisation of participants, either to a control or experimental group, has been acknowledged as another fundamental feature of this approach as it not only ensures that a representative sample has been included, but it reduces bias and the number of potential co-variants ([Nelson et al., 2010, p. 205](#)). However, as Punch (2009, p. 219) and Cohen et al. (2011, p. 322) pointed out, this can be very difficult to achieve in an education programme and, as a result, this threatens internal validity ([Polit and Beck, 2010, p. 246](#)). As my study was taking place in a University setting and following participants who were actually undertaking the second year of an adult nursing programme this posed a significant challenge. The participants were undertaking a nursing programme that had its content and timetable pre-set and, as a result, there was very little leeway to add content or extra timetabled sessions. The participants were also in fixed guidance tutor (GT) groups, which had been set at the start of year one of the programme. On average, each group contained twenty-five students and, once set, the students within each group were taught together in lectures, seminars and practicals.

One option open to me was to undertake my study out with the nursing programme and run it alongside it as an additional SBE programme, one that they could volunteer for. To do this I would invite the students undertaking the programme to participate in the study. Although this approach would offer greater control of the study variables, akin to a “laboratory study”, it raised a number of concerns that could lead to potential bias in my results ([Seers and Critelton, 2001](#)). Such as the recruitment of academically high-performing students who enjoyed SBE an issue found by Whyte and Cormier (2014) in their study, which they had to identify as a limitation. Additionally, this approach could add further pressure on the available resources in terms of staff time, SBE equipment and SBE suites, thus, potentially reducing the number of SBE sessions that could be



delivered over time. Linked to these issues, this could also potentially add pressure on the available students in terms of their time and academic and programme commitments, which could possibly limit the number of participants that could undertake the study leading to a small sample size (Boet, 2012). This would then exacerbate the impact of any attrition in the study population reducing its power (Peat, 2002, p. 132). Collectively, these could limit the external and internal validity of my study and the resourcing issues would this approach unachievable.

Another option was to actually follow the nursing students who were actually undertaking a programme. This offered a potential route to follow as it could potentially minimise the issues raised above and enable me to undertake my study in a more natural setting, an actual nursing programme. Students would then be recruited into my study from the existing population and from an ethical perspective they would be able to opt out at any time and their data removed. It would be made clear to them that as the SBE activity was part of their programme they would still have to partake in the activity but no information would be collected from them. In addition, as the study would be undertaken in an existing programme and, as such, it would attempt to address the operational scale issues faced by institutes when implementing SBE strategies, whilst ensuring that educational outcomes are achieved and maintained (Issenberg et al., 2011; Taylor and Geis, 2014, p. 265). This, therefore, appeared to be the most feasible option and, as Cohen et al. (2011, p. 323) stated, the effect of the threats to internal validity could be reduced by randomly selecting the natural occurring groups. The use of these naturally occurring groups in education, as suggested by Punch (2009, p. 219), would align the present study to a quasi-experimental approach. Consequently, this was adopted and, as Punch (2009, p. 220) identified, internal validity was

maintained by randomly selecting the natural occurring groups and statistically analysing the study variables.

### **4.3 – Study design, pre-test/post-test**

Due to its pragmatic approach, I adopted the widely used pre-test/post-test design (Cohen et al., 2011, p. 323; Polit and Beck, 2010, p. 227; Punch, 2009, p. 216) and, by collecting data, before and after the intervention, meant that I could detect, through more powerful statistical tests, any changes that occurred (Boet, 2012). This design was further strengthened by the inclusion of a control or comparison group as it would give a more robust understanding of the effect of the intervention and, as there were multiple data collection points, it would also give an understanding of its longer-term effects (Boet et al., 2012; Seers and Critelton, 2001). The latter was in line with the DP framework and the concept of developing skills overtime (Ericsson, 2004).

In addition to randomisation, Boet et al. (2012) identified a number of common biases found in quantitative research. To ensure that objectivity was maintained, minimise bias and reduce potential contamination of the results, I separated the staff delivering the intervention from those who were collecting the data (Topping, 2010, p. 134). As this was a quasi-experimental design, I would have to acknowledge the impact this approach would have on the external validity of the study and, as a result, I would not be able to generalise the findings to other populations or settings (Polit and Beck, 2010, p. 234); an issue I would make transparent throughout the research process.

## 4.4 - The sample

The first aspect I considered to ensure the rigour of my study was the sample and the actual numbers needed. Following a review of the adult nursing curricula, I chose to draw the sample from a cohort of adult nursing students who had entered year two of their three-year adult nursing programme. These were undertaking either the Bachelor of Science (BSc) or Advanced Diploma (AdvDip) routes, and as such I could effectively follow them for a full year of their programme. Academically at this point, the students in both programmes were studying at level five with no differences between the delivery and content of the two routes and, as a result, this would not influence the study. Once I had identified the sample, I then considered the study's statistical power. Field (2013, p. 69) described this as the ability of a study to detect a difference between interventions when an actual difference existed. However, there was a risk that I could detect an effect when one did not exist and, as a result, this would cause a type I error (Adamson and Prion, 2013b). The probability of an error occurring during my study could be controlled by establishing an acceptable risk level, known as the level of significance (Polit, 2010a, p. 98). As recommended by a number of authors (Field, 2013, p. 67; Livingston and Cassidy, 2005; Polit, 2010a, p. 98) I set the significance level at an  $\alpha$  (Alpha) of 0.05, which corresponded to a confidence interval of 95% reduction in the probability of a type I error. Sample size has been recognised as playing a crucial role in achieving this (Adamson and Prion, 2013b; Field, 2013, p. 71), with a larger sample size lowering the significance level (Adamson and Prion, 2013b; Polit, 2010a, p. 98). Conversely, there was a risk of a difference not being detected when one actually existed, a type II error, which I also considered and, I set an appropriate  $\beta$  (Beta) level (Field, 2013, p. 68). Livingston and Cassidy (2005) and Cohen (1988, p. 14) suggested that this should be set at eighty percent (0.8), which

would give an eighty percent likelihood that the statistical test would correctly identify a difference between the groups when a difference actually existed. As Adamson and Prion (2013b) observed, this left a twenty percent (0.2) chance that a difference would not be identified when there actually was one. Increased power is protective against type II errors, with the greater the power the less likelihood of a relationship that existed being missed (Adamson and Prion, 2013b).

Using the sample size calculator developed by the Clinical and Translational Sciences Institute (2016) I set  $\alpha$  at 0.05 and  $\beta$  (Beta) at 0.8, which calculated that a sample size of 126 would be needed. Unfortunately, due to a number of constraints; for example, the actual number of students available, the timeframe to collect the data in and timetabling of the SBE sessions, I could only use a sample of four GT groups. This gave a total sample size of 98 participants. The sample size was, therefore, insufficient to give an adequate power. To further compounded this, at the start of the study one participant withdrew their consent, so their data was deleted, and a further four participants left the programme over the course of the study, leaving 93 participants available to undertake the full study and its three phases. A problem that could impact negatively on my study.

However, Peat (2002, p. 131) recognised that when choosing a sample size there was a fine balance between the expected variance in measurements, the availability of participants and the feasibility of collecting the data. She continued that a  $\beta$  level of 0.8 in intervention studies was difficult to achieve (Peat, 2002, p. 132), and Black (1999, p. 394) also noted that quasi-experimental designs tended to have a lower power than experimental designs, and highlighted that error variance could be reduced by ensuring

that data collection tools were piloted and that they were valid and reliable. In addition, this could be further bolstered by choosing an appropriate statistical test, such as a parametric test, as these tended to be more powerful (Black, 1999, p. 394). As recognised by Livingston and Cassidy (2005), consideration should be given to whether or not the sample size estimate was feasible and they recommended that a range of sample sizes, based on different power levels, could be useful. Therefore, I repeated the sample size calculation (Clinical and Translational Sciences Institute, 2016) with an  $\alpha$  set at 0.05 and a  $\beta$  (Beta) set at 0.7 giving an estimated sample size of ninety-nine, and with an  $\alpha$  set at 0.05 and a  $\beta$  set at 0.6 a sample size of seventy eight was estimated. Due to participants leaving the programme and one withdrawing from the study, the  $\beta$  level fell between 0.7 and 0.6, giving between a thirty and forty percent chance of a type II error occurring. As Peat (2002, p. 132) acknowledged, the sample size calculations were rough measures of the minimum number of participants needed in a study. As the number of participants was closer to the 0.7  $\beta$  level, I adopted this as the most feasible level.

These power calculations worked for both the self-efficacy and knowledge data sets, but the total number of sub-groups for the performance data was sixteen and, as a result, this increased the risk of a type II error occurring. As this was the result of using a convenience sample of participants and the constraints of a real curriculum setting, which I had no control over, this would be acknowledged throughout the study. Since the power of a statistical test can be enhanced by randomisation (Adamson and Prion, 2013b) I, therefore, randomised the naturally occurring GT groups to maintain internal validity, as recommended by Punch (2009, p. 220). The groups were the comparison arm ( $n = 2$ ) who received the traditional SBE or the intervention arm ( $n = 2$ ) who received the Sim-TDP intervention. To reduce bias, this randomisation was performed

by the module coordinator who also allocated the GT groups their colour designation for example, blue and green (Intervention arm,  $n = 52$ ) and red and orange (Comparison arm,  $n = 46$ ). They then further divided the two GT groups in each arm into four sub-groups giving sixteen sub-groups ( $n = 8$  in the intervention arm, and  $n = 8$  in the comparison arm). Once randomised, the comparison and intervention arms undertook their SBE experiences in isolation of each other.

## **4.5 - Study variables**

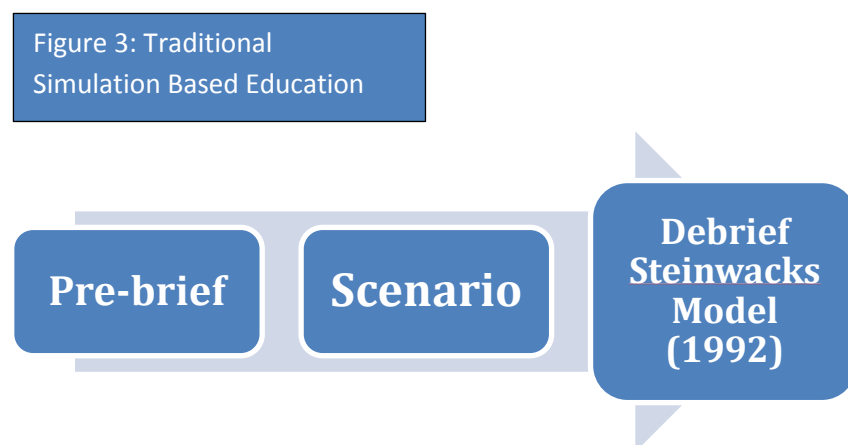
Once I had identified the study sample, I then progressed to exploring the variables that would be used within the quasi-experimental design. This included the identification of both the independent and dependant variables.

### **4.5.1 – The independent variable: Simulation with team deliberate practice**

#### **4.5.1.1 - Traditional SBE**

To address the gap in the literature and the challenges faced by nurse educators identified in the previous chapters, I developed an innovative approach to SBE delivery entitled Sim-TDP, the independent variable for this study. To achieve integration of this approach, I combined the DP framework (Ericsson, 2004), TDP and debriefing into the model. The aim was to optimise student performance. As the delivery of SBE

classically encompassed three stages; the pre-brief, clinical scenario and debrief (Lioce et al., 2015), I structured the SBE sessions using this framework (Figure 3), and from this, I developed a standardised SBE template to ensure that all the scenarios were delivered in the same manner (Lioce et al., 2015) (Appendix 2). These were underpinned by the standards of best practice for SBE as recommended by the International Nursing Association for Clinical Simulation and Learning's (INACSL's) "Standards of Best Practice: Simulation<sup>SM</sup>" (INACSL Standards Committee, 2016d). The pre-briefing stage focused on the effective preparation of the participants. The aims and objectives of the scenarios were defined, roles and expectations articulated and participants provided with the opportunity to discuss any concerns (Kardong-Edgren et al., 2008; Lioce et al., 2015; Lioce et al., 2013). The provision of well-defined goals was congruent with the first component of the DP framework (Ericsson, 2004; Ericsson et al., 1993).



The second stage, the actual scenarios, were based on the programme and module learning outcomes and specified curricula content. They were designed to represent a clinical situation that the participants may encounter during their clinical practice for example, an asthma attack. They also incorporated salient signs and symptoms that

patients would present with into their design such as a high respiratory rate. This was based on Brunswikian theory (1955) and the use of representative design features.

Another key element of the DP framework, was the provision of immediate feedback to the participants on their performance (Ericsson, 2004), a crucial element to the SBE process and fundamental to debriefing (Decker et al., 2013; Fanning and Gaba, 2007; Issenberg and Scalese, 2007; Issenberg et al., 2005; McGaghie et al., 2010; Rudolph et al., 2006). Thus, this was incorporated into the final stage of the SBE process. The debriefing stage, when facilitated by a skilled educator, accounts for the greatest proportion of learning in SBE as it allows participants the opportunity to critically reflect on their performance, develop their knowledge through the generation of new schema and in turn create future learning objectives (Cheng et al., 2014; Der Sahakian et al., 2015; Dufrene and Young, 2014; Fanning and Gaba, 2007; Issenberg and Scalese, 2007; McGaghie et al., 2010; Motola et al., 2013; Raemer et al., 2011). To ensure this was achieved members of the University's SBE teaching team, who were very experienced in the use SBE, facilitated all the sessions. To support this process, I adopted a structured debriefing model (Decker et al., 2013; Der Sahakian et al., 2015; Jones and Alinier, 2006). Although a number of debriefing models had been developed (Dreifuerst, 2015; Jaye et al., 2015; Rudolph et al., 2008; Zigmont et al., 2011) the model chosen was the three phase debriefing model developed by Steinwachs (1992) as this was familiar to all staff. The three phases of this model included a descriptive, analysis and an application phase. I developed a standardised proforma (Appendix 3) based on this model to guide the debriefing process and trained all facilitators in its use.

The descriptive phase aimed at providing participants with an opportunity to describe the events that had occurred during the scenario, which allowed them time to raise any



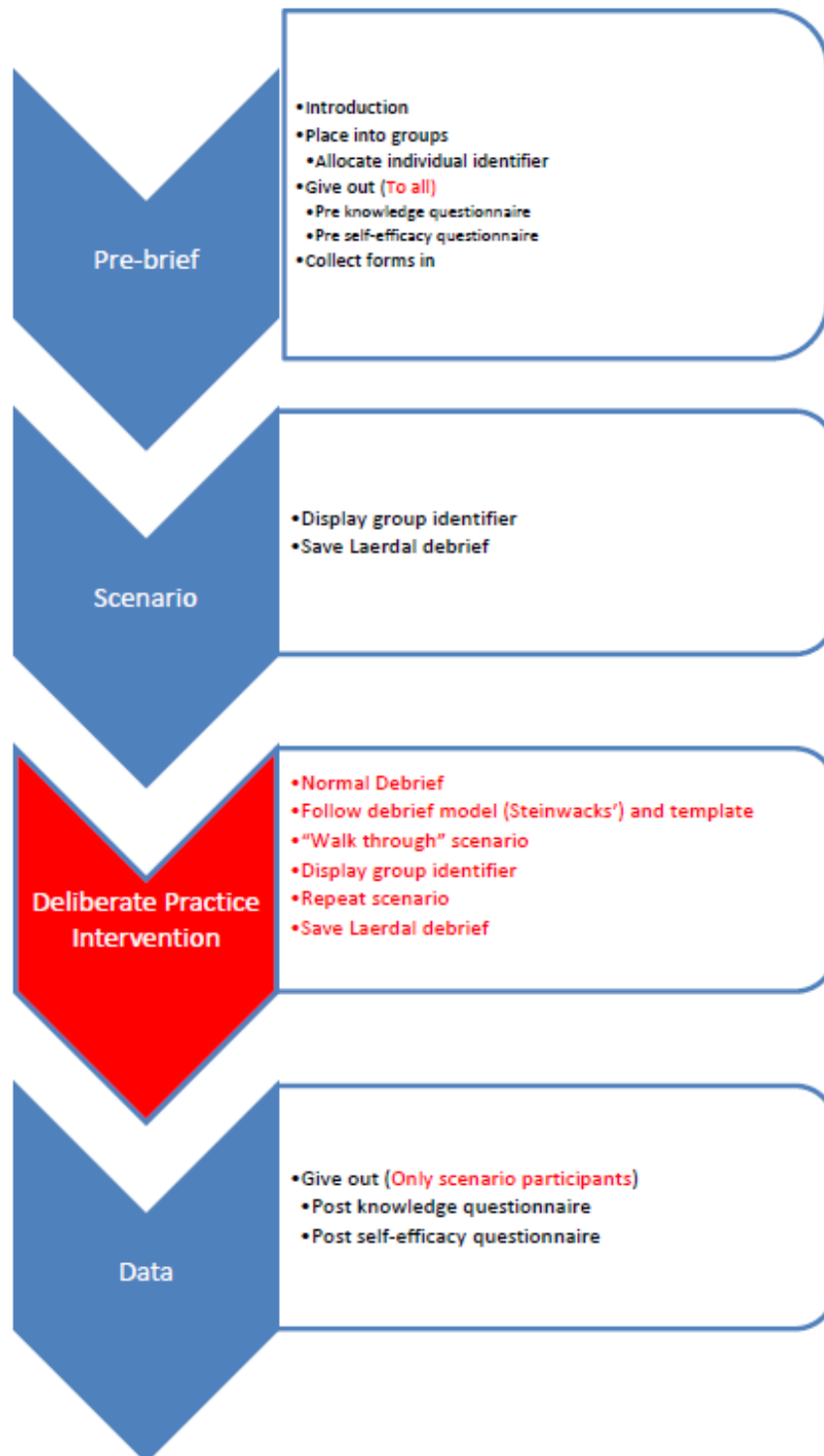
issues, concerns and to seek clarification of any issues (Steinwachs, 1992). In the analysis phase, they reviewed their performance under the guidance of an expert facilitator, who supported them to recognise areas of good practice and areas for development. This enabled them to identify their future learning needs and set new goals (Steinwachs, 1992), another key element of the DP framework (Ericsson, 2004). To further support the participants learning this phase was facilitated in a style advocated by Rudolph et al. (2006), the “debriefing with good judgment” approach. As a learner centred approach, it enabled participants to explore their actions and frames of reference so that these could be reflected upon and, if necessary, be reframed. A key factor in the adoption of this approach was that it valued both the expert opinion of the facilitators and the unique perspective of the learner and, as such, it avoided the humiliation a judgmental approach or the confused and mixed messages of the non-judgmental approach. This latter approach focused more on using protective social strategies such as giving compliment, followed by a criticism and then another compliment; or even through the avoidance of the problem altogether (Rudolph et al., 2006). The adoption of this method, enabled participants to explore and constructively critique their own performance and, as a result, begin to own their learning (Jeffries and Rizzolo, 2006). Although a number of studies (Chronister and Brown, 2012; Grant et al., 2010) have found that the use of video play back during the debriefing component was effective this approach was not utilised throughout the study. This decision was based on the concern of the academic staff that this may increase anxiety levels of the participants (Lestander et al., 2016; Pollock and Biles, 2016). The final phase was the application phase where the participants developed an action plan that outlined how they would meet their new goals and how they would apply these to their practice.

#### **4.5.1.2 - Simulation with team deliberate practice**

This three-stage approach also formed the foundation of the Sim-TDP (Appendix 1 and 5; figures 4 and 5). The difference in delivery occurred following the final phase of the debriefing process. At this point, the red section in figure 4, the intervention group continued with the Sim-TDP intervention and undertook a “walk through” of the scenario. This occurred back in the actual SBE environment where the learners were able to discuss the sequence of the scenario, explore their learning needs, and discuss their action plans in more depth with the facilitator. The facilitator, using a within-event structure, then gave the participants immediate feedback on their performance (Decker et al., 2013; Sawyer et al., 2016) and, if necessary, demonstrated any aspects of care or skills. Once completed, the participants then repeated the same scenario, an approach advocated by a number of authors (Sivertsen et al., 2016; Zapko et al., 2018; Zigmont et al., 2011). Zigmont et al. (2011) felt that the inclusion of a second opportunity to undertake the same or similar scenario enabled participants to apply their new knowledge and schema to deepen their learning. An approach that Scherer et al. (2016) in their quasi-experimental study, found led to a statistically significant improvement in performance. The final component was a final debrief. This meant that over the course of the Sim-TDP approach the participants repeated or rehearsed the scenario three times and undertook two debriefings.

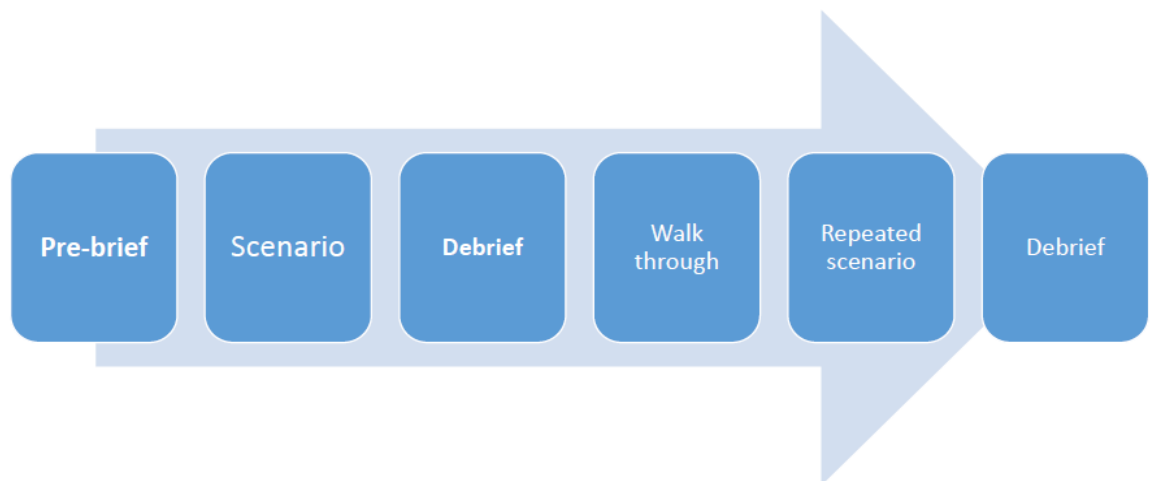
Overall, this approach was congruent with the DP framework (Ericsson, 2004) as the participants had the opportunity to further refine their performance through repeated practice facilitated by an expert educator, who during the Sim-TDP intervention acted as a coach to scaffold their learning (Wood et al., 1976). This approach was also consistent with the active experimentation phase of Kolb’s experiential learning theory (Kolb, 2015, pp. 31-64). This process was repeated at set points over the year in the

Figure 4: Simulation with Team Deliberate Practice - guide



subsequent phases, which were approximately at three monthly intervals. To ensure consistency, all facilitators were fully trained in the use of the Sim-TDP intervention.

Figure 5: Simulation with Team Deliberate Practice



#### 4.5.1.3 - SBE clinical scenario design

Prior to all the scenarios, the participants received a theoretical lecture based on the scenario; for example, shock and the use of a systematic assessment in recognising the deteriorating patient. A number of authors (Albarran et al., 2013; Smith et al., 2002; The Resuscitation Council (UK), 2015a) recommended the “ABCDE” (**A**irway, **B**reathing, **C**irculation, **D**isability and **E**xposure) mnemonic as systematic assessment framework, as it helps practitioners prioritise their actions and, as such, it was adopted. Once completed the “SBAR” mnemonic (**S**ituation, **B**ackground, **A**ssessment and **R**ecommendation) was then used as a structured handover tool (The National Patient Safety Agency, 2007).

#### **4.5.1.3.1 – Scenario fidelity**

To maintain fidelity, the scenarios were developed to be immersive representations of clinical situations that the participants may encounter in clinical practice (Lioce et al., 2015). Each scenario had a range of environmental cues, and the patient simulators were programmed with salient clinical cues that represented the signs and symptoms that would be found in a deteriorating patient. The SBE environment was set up to either represent a surgical or a medical ward with relevant equipment, for example oxygen masks, sphygmomanometer and patient records. The patient simulators used were Laerdal's SimMan® (Laerdal Medical, Stavanger, Norway), which were placed on a hospital bed, dressed in appropriate clothing with a patient identification band on. All participants, including facilitators, wore clinical uniforms. Depending on the scenario, a surgical wound, dressing and wound drain were attached to the patient simulators, or if required, a urinary catheter or intravenous cannula were inserted with intravenous fluids set up.

#### **4.5.1.3.2 – Clinical Scenarios**

In total six scenarios (Appendix 4) were used during the study, with each phase comprising two scenarios per phase. These were:

- Phase one (P1)

- A hypovolaemia scenario with a patient bleeding internally following abdominal surgery.
- A patient suffering an asthma attack.
- Phase two (P2)
  - A patient suffering from cardiac chest pain (Angina).
  - A patient developing sepsis following a urinary tract infection.
- Phase three (P3)
  - A patient suffering a Myocardial Infarction
  - A patient who had developed an anaphylactic reaction following the administration of an antibiotic.

Using the hypovolaemic shock scenario in P1 as an example, the participants would manage a surgical patient who had developed a post-operative internal abdominal bleed. The learning outcomes focused on the recognition of the signs and symptoms of deterioration and the participant's response. This recognition included the identification of the body's sympathetic response to a stressor such as:

- Tachycardia (Heart rate over 100 beats/minute).
- Tachypnea (A respiratory rate over 20 breaths/minute).
- Oliguria (Urine output of less than 30 mls/hour).
- Normal blood pressure (120/80 mmHg).
- Normal oxygen saturations (96%).

These signs and symptoms echoed the early stage of shock and, if suspected, the participants needed to use the “ABCDE” to assess the patient (The Resuscitation Council (UK), 2015a). The patient simulators were “voiced” by an experienced member of the SBE team so that the participants were able to communicate with the patient to elicit any relevant information. The patient simulators also had a number of anatomically correct features such as various pulse sites and they were also able to “breathe” as their chest rose and fell in line with the set respiratory rate. These features enabled the participants to record observations, as they would do on an actual patient. Recording a blood pressure also followed the exact procedure a practitioner would follow in a hospital environment.

#### **4.5.1.3.3 – Scenario delivery**

Due to the numbers of participants per group, the SBE sessions were delivered in tandem; for example, half of the group (twelve students) would undertake the “hypovolaemia” scenario whilst the remaining twelve would undertake the “asthma” scenario. These groups were further subdivided into two groups of six, with one group observing. The groups would then be reversed and those participants who had been observing would then undertake the second scenario; for example, if they had observed the “hypovolaemia” scenario they would undertake the “asthma” scenario. This approach had the potential to bias the results as the performance of those observing the initial scenarios could be positively affected. O’Regan et al. (2016) found following their systematic review that of nine studies they reviewed, four found better outcomes for hands-on learners compared to the observers and one study found better outcomes in the latter. They also found that the role of the observer, especially if

observer tools were used, was strongly associated with positive participant satisfaction and achievement of learning outcomes. However, Norman (2018) found in his study that there were no significant improvements in knowledge, self-confidence, or collaboration between baccalaureate nursing students. As the evidence does not explicitly identify a major effect and that both the comparison and intervention groups were undertaking the same process the impact of this approach would hopefully be minimised, this would have been acknowledged throughout the study as a limitation.

The time allocated in the curricula for this was three hours, with one hour each for the full scenario, including the debrief. The remaining hour was used for the pre-brief, transition times and a short break. The pre-brief incorporated a presentation of the aims and objectives, professional expectations and the roles of participants and facilitators. In addition to familiarising the participants to this learning and teaching methodology, a demonstration of the patient simulators and the environment was undertaken (Lioce et al., 2015). Detailed facilitator guides were developed for each scenario to ensure that they were delivered in a consistent manner (Figure 3 and Appendix 5). The immersive scenario commenced when the participants entered the SBE room where they received a “handover” of the patient from the facilitator. This outlined the patient’s history, records and progress during their hospital stay. During the scenario, they were expected to communicate with the patient to ascertain their status. Throughout, the participants worked as a team to assess the patient and document their findings. Once the participants had recorded all the data, they were expected to contact a senior colleague, who was played by the facilitator, to handover their findings using the SBAR tool and request assistance. At this point, the scenario ended as the participants had achieved the aims and objectives. This component was video captured for analysis. Once completed, the learners attended the debriefing and,



following this, the comparison groups completed their SBE experience whilst the intervention arm, in line with the study design, received the enhanced SBE intervention, Sim-TDP.

#### **4.5.1.4 – Pilot of clinical scenarios**

During the development stages of the study, I undertook a pilot study to ascertain whether the inclusion of the Sim-TDP intervention was feasible in the allotted curricula time frame. This was undertaken with four GT groups. During the initial run, the first group over ran by fifteen minutes, which was unacceptable, as participants had other timetabled sessions following their SBE exercises. The times, therefore, were reviewed and the pre-brief was subsequently shortened as much of the content was included in the previous sessions, which was removed leaving only the key scenario material. The transition times were also strictly adhered to for subsequent deliveries.

#### **4.5.2 - Dependent variables**

Once I had identified and developed the independent variable, I focused on the exploration of the dependant variables, which were the participant's performance, confidence/self-efficacy and knowledge and, in the process, developed a construct for each one. A vital step in developing an instrument to measure them (Polit and Beck, 2010, p. 67). These were outlined in detail in chapter 3.

### **4.6 - Research question**

Once I had explored the constructs of the independent and dependant variables, I was able to develop a more focused research question. This I based on the PICO framework. Firstly, I identified the population (P), then the intervention (I), followed by the comparative intervention (C) and, finally the outcomes (O) to be measured (Bettany-Saltikov and Whittaker, 2014). The research question was therefore, what was the effect of Sim-TDP, compared to traditional SBE delivery, within a structured SBE strategy on the performance, knowledge, and self-efficacy of second year adult nursing students? As the intervention could potentially have either a positive or negative impact on the dependant variables I adopted a two tailed test (Field, 2013). In keeping with the research paradigm, I hypothesised that:

- 1)  $H_1$  - Following the introduction of Sim-TDP, the adult nursing programme students in the intervention group would have significantly different mean scores in the post test than the comparison group with respect to their:
  - a. Performance ( $H_{1.1}$ )
  - b. Self-efficacy ( $H_{1.2}$ )
  - c. Knowledge ( $H_{1.3}$ )

- $H_{01}$  - The null hypothesis being that, following the introduction of Sim-TDP, there would be no difference post-test between the adult nursing programme students in the intervention and comparison groups in relation to their:
- a. Performance ( $H_{01.1}$ )
  - b. Self-efficacy ( $H_{01.2}$ )
  - c. Knowledge ( $H_{01.3}$ )

2)  $H_2$  - The mean scores of the adult nursing programme students following each phase of the research study would differ significantly to those in the intervention group with respect to their:

- a. Performance ( $H_{2.1}$ )
- b. Self-efficacy ( $H_{2.2}$ )
- c. Knowledge ( $H_{2.3}$ )

$H_{02}$  - The null hypothesis being that the scores of the adult nursing programme students in the intervention group would not differ significantly following each phase of the research study in respect to their:

- a. Performance ( $H_{02.1}$ )
- b. Self-efficacy ( $H_{02.2}$ )
- c. Knowledge ( $H_{02.3}$ )

3)  $H_3$  - Following the introduction of Sim-TDP the time on task of the adult nursing students in the intervention group would be significantly different from the times of the comparison group.

$H_{03}$  - The null hypothesis being that following the introduction of Sim-TDP there would be no difference between the time on task of the adult nursing students in the intervention and the times of the comparison group.

By aiming to investigate the effect of Sim-TDP, compared to a traditional SBE approach, within a structured SBE strategy on students' performance, knowledge and self-efficacy, the study had a number of distinct features. It was investigating the use of SBE as a learning and teaching methodology and, more specifically, the use of DP and TDP in nurse education. The progressive use of DP in a real setting, such as a nursing

curricula or, the use of TDP in nursing SBE, had not been explored in the literature. Therefore, not only would the study add to the existing understanding of SBE, DP and TDP, it would also add specifically to the nurse education literature.

## **4.7 - Data collection**

### **4.7.1 - Data collection process**

Once the research hypotheses were set, I concentrated on the actual data collection process and the development of the data collection tools. As I was aiming to compare the enhanced SBE activity, Sim-TDP, against a traditional approach, the design of study was directed towards comparing the performance scores of both arms of the study (Figure 6). Since the initial video of the student's performance captured for the intervention arm was prior to them receiving any form of debriefing, I termed this as their "pre-performance" video. The second video captured for this arm followed the Sim-TDP intervention and I therefore termed this the "post-performance" video. As the comparison arm only had one video of their performance captured, prior to their debriefing, this could be used as both their "pre and post-performance" video. These formed the data points where I could collect and compare the performance data. I undertook this analysis at a sub-group level and compared the group performance scores repeating this process for each of the three phases.

This approach was undertaken as the study was comparing Sim-TDP with a traditional SBE approach and the traditional SBE approach did not have a repeated scenario in its

design. Undertaking further video capture of the comparison groups would entail them undertaking a repeat of the scenario, which would mean that they were undertaking an element of TDP. This would mean that it was no longer a traditional SBE approach and that both the intervention and comparison groups would be undertaking near identical approaches. Therefore, I could not undertake additional video capture of the comparison groups.

The self-efficacy and knowledge questionnaires (Figure 7) were administered prior to the SBE activity as a pre-test and, then subsequently, following the completion of the whole SBE activity as the post-test.

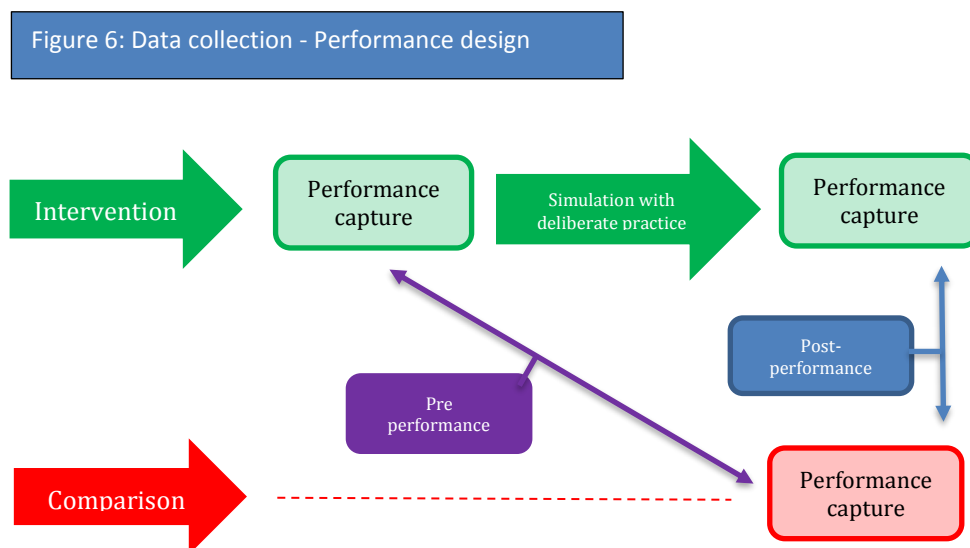
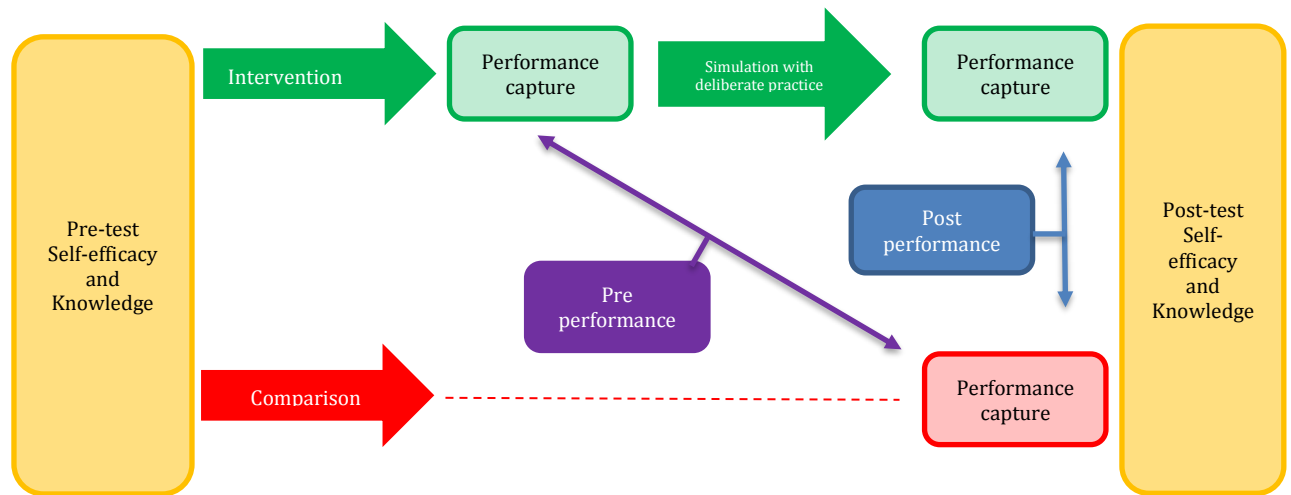


Figure7: Data collection - Knowledge and self-efficacy



## 4.7.2 - Development of data collection tools

### 4.7.2.1 – Overview of tool development

#### 4.7.2.1.1 – Tool validity

Once the data collection process had been established, I concentrated on the development of the actual data collection tools. As SBE was measurable and reproducible, it allowed me the opportunity to observe the participants' performance (Devita, 2009; Rosen et al., 2008). This ability to consistently reproduce scenarios was crucially important to my study and to the quantitative process I had adopted (Topping, 2010, p. 134). However, this required an evaluation strategy, including a data collection tool, that would provide a valid, reliable, and accurate measurement that quantified

performance (Lammers et al., 2008). In addition, before an instrument could be used, it was important that I gave consideration to whether it was a valid and reliable measure for the study population (Adamson et al., 2013). Validity in this sense referred to whether an instrument actually measured what it purported to measure; an essential criterion for evaluating those methods used to measure variables (Field, 2013, p. 12; Maltby, 2010, p. 245; Polit and Beck, 2010, p. 377). Topping (2010, p. 139) and Black (1999, p. 57) referred to two forms of validity the first of which was external validity, which they described as the degree to which the findings of a study were be generalisable to other populations. The second, internal validity, was the extent of what was being observed truly represented the variable under investigation (Topping, 2010, p. 139). In terms of the latter, Polit and Beck (2010, p. 377) identified three elements that were important in establishing the validity of an instrument: content validity, criterion related validity and construct validity. Content validity referred to whether or not the items on an instrument were relevant, denoted the subject matter and represented the construct that was being measured (Adamson and Prion, 2012b; Brett-Fleegler et al., 2008; Polit and Beck, 2010, p. 377). As recommended by Polit and Beck (2010, p. 378) to establish content validity, I needed to undertake a literature review to establish the items on the instrument and then use a panel of experts to evaluate the content. These then had to compared to the established gold standard for the variable being measured, which would, in the process, establish criterion validity (Brett-Fleegler et al., 2008).

I also explored the construct validity of the tools and whether they measured the actual variable in question (Polit and Beck, 2010, p. 379). However, I found a great deal of debate in the literature regarding the concept and application of construct validity to research studies. The term construct validity was first introduced by Cronbach and Meehl (1955) to conceptualise validity in terms of psychology research.

This view held that construct validity was an umbrella term that encompassed other complementary types of validity such as content and criterion that could be integrated into an overall judgment of construct validity (Cronbach and Meehl, 1955; Downing, 2003; Messick, 1995, 1998). In this view of construct validity, the actual construct, such as intelligence or professionalism were abstract theoretical terms defined by their relation to other constructs or theories (Colliver et al., 2012). This shifted the focus of thinking from the validity of the test to the validity of the interpretations of the test score (Borsboom, 2012; Borsboom and Markus, 2013; Colliver et al., 2012). However, Borsboom et al. (2004) questioned this focus and argued that if something did not exist, then it could not be measured. They acknowledged that this concept appeared to be exceedingly simple but reasoned that a test was only valid for measuring an attribute when (a) the attribute existed and (b) any variations in the attribute causally produced a variation in the measurement outcomes. They referred to this as test validity (Borsboom et al., 2004).

This causal analysis resonated with me as it aimed at defining measurement in terms of what could be measured and what counted as measurement (Colliver et al., 2012). Colliver et al. (2012) maintained that this approach was much more appropriate in healthcare education as the view of construct validity, as an umbrella term, weakened the concept of validity as they were based on abstract theories. Colliver et al. (2012) continued that the focus should be more on an attribute-based view of measurement, which they argued avoided the problems associated with establishing the validity of abstract theoretical constructs. Lurie (2012) agreed, and believed that it was more appropriate to measure competence in terms of performance rather than competency in its broader sense. As Borsboom (2012) pointed out, an assessment of a pulse rate was designed to measure heart rate, and that a breathing assessment was designed to measure the regularity of breathing and, therefore, argued that these relationships



were well understood and did not need a convoluted theoretical construct to justify their use in a test. In essence, they could be measured to assess their causal effect on an outcome (Colliver et al., 2012). This view was congruent with the aims of the study and, as a result, could be adopted to evaluate the impact of the Sim-TDP intervention on the competence of the participants and measure their actual performance (Eraut, 1998; Fastre et al., 2010; While, 1994), and not the broader theoretical construct of competency.

#### **4.7.2.1.2 – Tool reliability**

It was not only important to establish the validity of the data collection tools but it was also imperative to test their reliability, another major criterion to assess the quality of a quantitative research study (Griffiths and Rafferty, 2010, p. 414; Polit and Beck, 2010, p. 373). In terms of my study, reliability provided the consistency that would make validity possible (Kardong-Edgren et al., 2010) and, as pointed out by Sharts-Hopko (2002), it was reliability that came first as the data must be reliable in order for it to be valid. Since reliability, also known as “reproducibility” or “precision,” referred to the consistency of the results, it was vital that the data collection tool assessed what I intended it to measure, and that it yielded similar results over the course of the study (Griffiths and Rafferty, 2010, p. 408; Kardong-Edgren et al., 2010; Lammers et al., 2008; Tolmie et al., 2011, p. 146). This reduced the risk of potential errors in the data (Bruton et al., 2000). However, as Bruton et al. (2000) discussed, there was no single test that was sufficient to provide a full picture about reliability and, subsequently, they recommended that a combination of different types of test should be used. Tolmie et al. (2011, p. 146) further elaborated on this and recommended that, for small scale studies, the aim was to establish the reliability of the measurement tools and that these

should be assessed and reported on during the summative stage of the data analysis.

An approach that I adopted.

In terms of the tests, Polit and Beck (2010, p. 373) identified three aspects to reliability, the first of which was stability. They described this as the extent to which an instrument produced similar results on the same sample population on different occasions and, continued that this was usually assessed using a test/re-test procedure. However, whilst the test-retest concept had been seen as the foundation of most reliability estimates used in healthcare education, the actual test/re-test design was rarely used as it was logistically difficult to undertake (Downing, 2004). Consequently, due to the time constraints on my study and, that it was set in a real curriculum, I felt that the adoption of a test/re-test method was not a feasible option. The second aspect of reliability was the measure of the tools internal consistency and the extent that the items on the tool measured the same trait (Black, 2002, p. 86; Polit and Beck, 2010, p. 375). This was tested by using Cronbach's alpha ( $\alpha$ ) (Adamson and Prion, 2013c; Downing, 2004) but, as it related to construct validity (Downing, 2004; Polit, 2010b, p. 354; Polit and Beck, 2010, p. 375) it was not congruent with the test validity approach I had adopted (Borsboom, 2012; Borsboom and Markus, 2013; Colliver et al., 2012).

I had adopted the test validity approach in the development of the performance tool because it used a realist and causal analysis approach aimed at defining measurement in terms of what could be measured (Borsboom et al., 2004). This was consistent with the description of competence identified previously. As a result, this allowed me to focus on the actual attributes that existed and, any variations in these captured as they would cause a variation in the measurement outcome (Borsboom et al., 2004). In

addition, the patient simulators had a high degree of reliability as they could be programmed and, as a result, were able to consistently present physiological parameters in the same manner for every participant, minimising the variability inherent in actual clinical encounters (Adamson and Prion, 2012a; Scalese et al., 2008). This approach would also ensure the tool was population specific; an important aspect to acknowledge in terms of the reliability of the data (Adamson and Prion, 2012a).

Another aspect of reliability that I had to guarantee was that all the raters scored the participant's performance in a consistent manner over the course of the study (Maltby, 2010, p. 246). As the performance data collection depended on human raters it was the reliability or consistency between them that was of concern (Downing, 2004). This was the third aspect of reliability identified by Polit and Beck (2010, p. 373), which they termed equivalence. They related this to the degree that two or more observers agreed about the scoring on the data collection tool. This could be difficult to establish but it was vitally important to achieve when evaluating SBE (Kardong-Edgren et al., 2010) and, it could be assessed through the use of inter-rater reliability approaches (Polit and Beck, 2010, p. 375). The exact approach adopted depended on the type of evaluation being used, with an internal consistency approach being used for cognitive based instruments and, interrater consistency or agreement approaches being used for rater-based evaluations (Downing, 2004).

Downing (2004) recommended using the intra-class correlation (ICC) coefficient method for estimating inter-rater reliability, as it was an accessible method and, it supported a rigorous orientation process for raters/observers (Manz et al., 2013). Using the analysis of variance (ANOVA) method, ICC estimated any variance in the reliability

of the data by calculating the variance estimates obtained through the partitioning of total variance of the between and within subject variance (Downing, 2004). As a result, it reflected the degree of consistency and agreement among raters both between and within the groups of my study (Bruton et al., 2000). Downing (2004) pointed out that the strength of using ICC for inter-rater reliability was that it was easily computed using available statistical software and permitted the estimation of the actual interrater reliability for all raters used in a study.

In order to measure the effect of introducing the Sim-TDP intervention on the dependent variables of the participant's performance, knowledge and self-efficacy the principles of validity and reliability were adopted to develop both the performance measurement tool and the two questionnaires to measure participants' knowledge and self-efficacy.

#### **4.7.2.2 - Performance tool development**

Due to the large class sizes and the limitations in the resources available, the SBE sessions had to be delivered to small groups of students. This meant that the performance tool had to be designed for use with a team of participants, measuring their achievement of the sessions learning outcomes as a group (Kardong-Edgren et al., 2010). To develop the performance tool, following the validity and reliability principles identified previously, I initially reviewed the literature to identify if there were tools available. This revealed that a number of authors had developed tools to evaluate student learning in SBE. These ranged from tools that measured the various domains of learning (Clark, 2006; Lasater, 2007; Radhakrishnan et al., 2007; Todd et al., 2008a)

to those that focused on assessing performance (Arnold et al., 2009; Liaw et al., 2011; Merriman et al., 2014; Stayt et al., 2015). In relation to the former evaluation tools, Clark (2006) developed the “Clinical Simulation Performance Grading Rubric”, a six-category tool developed to assess the performance of student midwives. Although she gave a brief overview of the theoretical underpinnings of the tool, she did not report on its validity or reliability. This was also evident in the sixteen category “Clinical Simulation Evaluation Tool” (CSET) developed by Radhakrishnan et al. (2007) to evaluate the performance of senior nursing students. They did not offer an explanation about how the tool was developed and what measures they used to ensure the validity and reliability of CSET.

In 2007, Lasater developed the “Clinical Judgment Rubric” (LCJR), which was based on the Clinical Judgment Model developed by Tanner (2006). As with the previous instruments reviewed, the author did not offer an explanation in relation to the validity and reliability of the LCJR. Using a more robust approach, Walshe et al. (2014) developed the “Detect Deterioration, Accurate Assessment, Rapid Response, and Effective Escalation (DARE<sup>2</sup>) – patient safety rubric” to evaluate the performance of final year nursing students. The rubric was based on four domains: a systematic patient assessment, the clinical response, the student’s psychomotor skills, and their communication proficiency. The researchers adopted an experimental quantitative exploratory design using four raters to review the performance of thirty-four nursing students. They found that the rubric had an excellent inter-rater reliability (ICC coefficient of 0.75) and, recommended that further research should be undertaken into its use.

A tool that has had significant interest in its use was the “Simulation Evaluation Instrument” (C-SEI) developed by Todd et al. (2008a). This was a four-category tool aimed at assessing critical thinking, communication, assessment and technical skills. The authors established content validity through an extensive literature search and expert panel review and, demonstrated a faculty inter-rater agreement of 81.3%. Since its initial development, other researchers have tested this tool further and, in a study by Adamson et al. (2011) further evidence was established of the tools inter-rater reliability. The authors demonstrated an ICC of 0.952 (95% confidence interval, 0.697, 0.993), an intra-rater reliability of 0.883 (95% confidence interval, -0.001, 0.992), and an internal consistency of:  $\alpha$  (Cronbach’s alpha) = 0.979. They acknowledged, however, that the confidence intervals were wide and, felt that this was due to the limited number of scenarios and the small number participants. Consequently, recommended further research in this area.

This tool was subsequently adapted by Hayden et al. (2014a) who renamed it the “Creighton Competency Evaluation Instrument” (C-CEI) and, undertook further tests on its validity and reliability. They found that the content validity on a four-point Likert-like scale ranged from 3.78 to 3.89, and that inter-rater reliability had a Cronbach’s alpha of  $\alpha > .90$ . They concluded that the C-CEI was a valid and reliable instrument that could be used to assess clinical competency in pre-licensure nursing students in both SBE and traditional clinical environments. As a result, this was successfully used in the National Council of State Boards of Nursing’s (NCSBN) national simulation study (Hayden et al., 2014b). A longitudinal, randomised controlled study investigating the effects of replacing clinical hours with SBE on pre-licensure nursing students in the USA.

This review indicated that the DARE<sup>2</sup>-patient safety rubric and the C-CEI tools offered a viable method of evaluating the performance of the participants in my study. However, as Adamson et al. (2013) noted, it was not enough to select a tool with high reported reliability and validity but, consideration should be given to whether the instrument was appropriate for the population being studied. In general, as recommended by Rosen et al. (2008), the best model was one that was tailored for a specific domain, had received empirical validation, focused on observable behaviours and, limited the sources of errors between raters. As the development of the performance tool was not aimed at developing a generic tool that could be used throughout a three-year nursing programme, but focused on developing a tool that would specifically measure the performance, related to a series of representative tasks, of year two adult nursing students. I, therefore, had to question the use of these broad tools in my study. As Liaw et al. (2011) contended, the C-SEI/C-CEI tool was developed to evaluate student performance in all educational domains and across a wide range of SBE activities, which was also true of the DARE<sup>2</sup>-patient safety rubric. The C-SEI/C-CEI tool was also used by Hayden et al. (2014b) to evaluate the performance of students in clinical practice once they had qualified. As a result, these tools could not be used to rate the performance of participants in my study as they covered too broad a range of educational levels and learning environments and, consequently, were not specifically designed for the level of the participants in my study. I therefore began the process of reviewing the performance based tools.

As Ericsson (2004) recommended, the first step in evaluating a DP intervention was to construct a list of representative tasks that captured the performance of an individual in a consistent and reproducible manner. These could then be used to identify aspects of the performance that could be improved (Ericsson, 2015). This was echoed by Rosen

et al. (2011) who felt that an event-based measurement tool was a valuable approach to adopt as it offered some control over cues. When linked to explicit learning outcomes, set at the student's current level of performance, they became an essential component of learning (Ericsson, 2004; Ericsson, 2015; McGaghie et al., 2006; Vygotsky and Cole, 1978). In relation to my study, these would be set around the early recognition of a deteriorating patient and include relevant physiological, pathophysiological and environmental cues that a patient would present with. This task focused, or taskwork, team training approach would not only enable members of the team to become more aware of each other (Salas et al., 2008b) it would also be a good indicator of the effectiveness of team coordination (Nadler et al., 2011). As a result, the scenarios and not only reflect the taskwork components of team training but also the coordination component of teamwork. As these tracks would be developed separately during the early stages of the participant's training they would build a solid foundation for them to develop from (Glickman et al., 1987; Mathieu and Rapp, 2009). Additionally, as Lammers et al. (2008) pointed out, defining the detailed steps of a procedure was a prerequisite to both training and testing. Especially when they were linked to scenario events an observer could focus on these critical aspects of performance, which reduced their overall attentional demands and, as a result, increased reliability (Rosen et al., 2008). This approach appeared congruent with the performance-based criteria method for assessing competence discussed previously (Fastre et al., 2010).

I, therefore, developed event-based or performance-based tool (Fastre et al., 2010) that was based on the appropriate representative tasks (Ericsson, 2004) that through a realist, causation approach could be measured (Borsboom et al., 2004; Colliver et al., 2012; Lurie et al., 2011). I started this process by reviewing the learning outcomes of the SBE sessions to establish a clear link between them and the elements of the



performance tool (Rosen et al., 2008). The aim of the SBE scenarios were to develop the participant's skills in the recognition of and response to a deteriorating patient.

Subsequently, the learning outcomes of the sessions were:

- To assess the patient utilising the ABCDE assessment mnemonic (The Resuscitation Council (UK), 2015a), and demonstrate accurate record keeping.
- To communicate effectively with all members of the team, and hand over using the "SBAR" mnemonic tool (Patient Safety First, 2008; The Resuscitation Council (UK), 2015a).

The performance tool was, therefore structured, using the "ABCDE" assessment framework (The Resuscitation Council (UK), 2015a) and "SBAR" handover (Patient Safety First, 2008; The Resuscitation Council (UK), 2015a) mnemonics. Content validity was established over a number of phases, which were:

1. A literature review to identify appropriate checklist items.
2. Internal expert panel review (departmental level).
3. External expert panel review (across both the University's Faculties and outside organisations) and, through item-level content validity index (CVI-I) testing.

A detailed account of this process can be found in appendix 6.

I heeded Adamson and Prion (2012a) and their warning that the reliability of data was very population specific and assumptions could not be made that the same inter-rater reliability would be achieved when the instrument was used on a different population of participants. To ensure the continued reliability of the data during the main study, all

the videos captured (N = 59) were not only reviewed and scored by myself but, also by two independent raters (N = 3). The data collected was analysed for inter-rater reliability using the ICC method and a Cronbach's  $\alpha$  of 0.71 (95% confidence interval: 0.55 – 0.84), was found. Although this was lower than the ICC found in the initial tool development, it was still above the 0.70 threshold (Downing, 2004) and, therefore, demonstrated the continued reliability of the tool. The scores for each item from the raters (N = 3) was reviewed further to establish the final score for each item, which was based on a consensus agreement. This was undertaken by assessing the average score for each item and, if there was consensus between two or more raters, this score was accepted as the final score for that item. The final score was then entered as the score for that sub-group. Once the performance tool was finalised the development of the self-efficacy tool was then undertaken.

#### **4.7.2.3 - Self-efficacy questionnaire development**

The inclusion of this tool was aimed at identifying whether the Sim-TDP intervention effected the self-efficacy of the participants in their recognition and management of a deteriorating patient. To measure this I adopted a questionnaire approach as this method was an appropriate technique to use when faced with a large sample sizes and, where there were time and resource constraint (Maltby, 2010, p. 108; Polit and Beck, 2010, p. 345). It also, as Polit and Beck (2010, p. 345) identified, gave the participants a greater sense of anonymity. As identified by a number of authors (Göb et al., 2007; Griffiths and Rafferty, 2010, p. 412; Polit and Beck, 2010, p. 346) it was also an appropriate technique to use to evaluate participant perceptions. According to Göb et al. (2007) the most popular scales were the five-grade and seven-grade Likert scales, which consisted of several declarative items along a continuum that

respondents highlight to indicate how much they agree or disagree with a particular statement (Polit and Beck 2010, p.346). Through the assignment of a numeric score to these items, they can be measured at an ordinal level (Jones and Rattray, 2010, p. 376). At this level, Jamieson (2004) recommends a non-parametric test should be used, however, Norman (2010) disagrees and, argues that a parametric test could be used with Likert scale data. As Carifio and Perla (2008) reasoned, it was perfectly appropriate to summarise the ratings generated using the means and standard deviations of this data through such parametric techniques as an ANOVA, provided that the assumptions were clearly stated, and the data was of an appropriate size and shape (Pell, 2005).

I developed seven questions that were specifically related to the self-efficacy of the participants and as Göb et al. (2007) recommended each item was measured using a five point Likert scale with strongly disagree, disagree, undecided, agree, and strongly agree set as the declarative points on the scale. The most positive response, strongly agree, was graded 5 (Griffiths and Rafferty, 2010, p. 412). As Perry (2011) noted, self-efficacy was very context-specific and, that it also related to very particular tasks, therefore, the questionnaire was designed to capture the participants' reports of their perceived self-efficacy related to the specific SBE learning outcomes and not the theoretical construct of confidence; for example, "I am confident using the ABCDE approach to assess a patient". In terms of validity, it was, therefore, not measuring a theoretical concept (Borsboom et al., 2004; Colliver et al., 2012), and as such, I did not undertake the specific tests for construct validity. Nevertheless, as recommended by Polit and Beck (2010, p. 245), I did aim to establish the appropriateness of the items to be included through a departmental expert panel (N=6). A focus of the review was to ensure that the questions reflected the SBE learning outcomes. These were checked in

terms of content, relevance to the scenarios, clarity and whether or not they were “leading” in nature (Maltby, 2010, p. 110). I then tested them in the pilot as recommended by Polit and Beck (2010, p. 345).

During this process, the structure and the content was agreed (Appendix 8) and, any necessary amendments made. It was noted during this time that two of the items had questions that were framed in a negative manner; for example, “I do not feel confident handing over to a senior colleague using the SBAR framework”. This meant that for these questions a grade of five gave the most negative response, which was strongly disagree. The scoring for these questions was, therefore, reversed to ensure that a high score consistently reflected a positive response (Polit and Beck, 2010, p. 347). This mixture of questions also avoided the potential danger of an acquiescent response bias and, the tendency of the participants to agree with a statement or to respond in the same manner to all questions (Jones and Rattray, 2010, p. 376). Once completed I started the development of the knowledge tool.

#### **4.7.2.4 - Knowledge questionnaire development**

By including this tool in my study I aimed at identifying whether the use of the Sim-TDP intervention effected the participant’s knowledge and, once again, a questionnaire approach was adopted. As recognised by Anderson et al. (2001) learning in the cognitive domain includes the acquisition and recall of facts, concepts, and principles that can be set within Bloom’s taxonomy of learning domains (Bloom, 1956). This taxonomy identified six hierarchical levels of learning that included remembering, understanding, applying, analysing, evaluating and creating (Anderson et al., 2001;

Bloom, 1956). Although the lower levels had been identified as a simple and “quick” target to measure student learning (Kardong-Edgren et al., 2010), a number of authors (INACSL Standards Committee, 2016b; Lioce et al., 2015; Lioce et al., 2013; Sando et al., 2013) recommended that learning outcomes in SBE should be set at the level of application.

The knowledge questionnaire was designed based on these recommendations and the questions were set at the application level to explore the participant’s knowledge of the scenario. A mixture of multiple-choice questions (MCQ) and free text questions were incorporated into the design. In the MCQs, a stem question was asked; for example, “In the SBAR framework “S” means?” The aim of this was to ascertain the participant’s knowledge of the framework and its application. The participants were provided with four possible options with only one of the answers being correct. The free text questions were designed to allow the participants to demonstrate a greater understanding of the topic and the application of this knowledge to practice; for example, “Agitation/confusion can be an early sign of patient deterioration identify one reason why?”. Several correct answers were identified during the development stages of the questionnaire with a correct answer scoring two and an incorrect answer scoring one. A score of zero was given if a question was not answered. As each participant received a score between 0 – 20, the level of measurement was categorised as a continuous variable and, more specifically, a ratio variable (Field, 2013, p. 10; Prion and Adamson, 2013; Walters and Freeman, 2010, p. 437).

The questionnaire was designed to specifically test the participant’s knowledge of the scenario and the learning outcomes set at the application level in Bloom’s taxonomy

(Anderson et al., 2001; Bloom, 1956), and not the theoretical construct of knowledge. It was therefore in terms of validity, measuring what existed and, so what could be measured and not a theoretical concept (Borsboom et al., 2004; Colliver et al., 2012). As a result, I did not undertake the tests for construct validity, an approach that Daniels et al. (2010) successfully adopted in the development of their multiple-choice questionnaire (MCQ). Once again, as recommended by (Polit and Beck, 2010, p. 245) I aimed at establishing the appropriateness of the items to be included in the knowledge questionnaire through an expert panel review (Polit and Beck, 2006).

The departmental expert panel was utilised (N=6) and they reviewed the questionnaire to ensure that the questions reflected the SBE learning outcomes. The questions were checked in terms of content, relevance to the scenarios, clarity and whether or not they were leading (Maltby, 2010, p. 110). Once the questions had been agreed, I undertook a further review by colleagues outside the Department (N=6). The members of this second panel comprised of advanced practitioners (n=6) who had expertise in critical care practice. The questions were then tested during the pilot (Polit and Beck, 2010, p. 345). During this process the structure and the content was agreed and, the wording of the questions was refined. One area that had to be reviewed was the range of possible correct answers for the free text questions. This was expanded to encompass several answers identified during the pilot. At this stage, the questionnaire was returned to the departmental panel for final review and approval (Appendix 9).

## **4.8 – Ethical considerations**

Ethical approval was sought from the University's research and ethics committee and submission followed the principles outlined in Northumbria University's "Research Ethics and Governance Handbook" (Northumbria University, 2014). As ethical researchers have to use strategies that minimise all types of harm and discomfort that may occur to participants (Polit and Beck, 2010, p. 121), I focused particularly on their dignity, rights, safety and wellbeing. In doing so, as a registered general nurse, I adhered to the code of professional standards of practice and behaviour for nurses and midwives (Nursing and Midwifery Council, 2015) and, as an employee of the University, I also followed the code of research ethics and governance (Northumbria University, 2014). Accordingly, I observed the principles of respect for autonomy, non-maleficence, beneficence and justice that underpin medical research (Beauchamp and Childress, 2013, pp. 101-293).

Obtaining informed consent was vital in maintaining and respecting participant's autonomy and, this meant that the participants were able to make a free, independent and informed choice, without any coercion, about whether or not they wanted to take part in the study (Cohen et al., 2011, p. 78; Maltby, 2010, p. 348). To make an informed voluntary decision, full disclosure was necessary (Polit and Beck, 2010, p. 123). I therefore, gave a detailed account of the study to all potential participants, both verbally and in writing and, clearly outlined the risks and benefits of the study. Accordingly, an invitation letter (Appendix 10), consent form (Appendix 11) and a study information sheet (Appendix 12) was sent to all potential participants.

The participants were informed that their participation was on a voluntary basis and I emphasised that they could refuse to take part in the study and opt out at any time and, in doing so, this would not affect them in anyway. However, as the SBE sessions were

part of their nursing programme, they were informed that they would still have to participate in the activity but, any data relating to them would not be used and, that this would be destroyed as confidential waste. It was also emphasised that if they did agree to take part in the study, they could withdraw at any time and, again without any recriminations. To support this, I ensured throughout the study that the participants were given the opportunity to review their participation. My contact details together with that of my principle supervisor were provided so that they could contact us to clarify any information they had received and, as such I adhered to the principle of justice (Polit and Beck, 2010, p. 124). Confidentiality and privacy were also maintained (Cohen et al., 2011, pp. 90-92; Polit and Beck, 2010, p. 125). The importance of confidentiality was highlighted to all participants and I emphasised that they would be allocated a unique identifier, which would be used to identify their actual videoed performance and questionnaires. The identifying codes were stored in a different place from the video recordings and all information/data collected was securely stored in a locked filing cabinet until the study was completed. All electronic information was stored on the University's secure 'U' drive and, was password protected. All research documentation and data would be retained for a period of five years and then destroyed as confidential waste (Northumbria University, 2014).

It was also imperative to place the participant's well-being first by following the principle of non-maleficence and, do no harm (Cohen et al., 2011, p. 85; Maltby, 2010, p. 349). I acknowledged my position within the University but emphasised that my role was purely a one of data collection and that I would not be participating in the SBE sessions. Once again, to avoid coercion, I made it explicit that their decision to either participate or not in the study would not affect their course work or progression. I



reinforced this further by acknowledging that I was a member of staff from a different department and, as a result, I did not have any input into their programme.

Additionally, no undue distress was anticipated but I remained vigilant in anticipating such dangers (Polit and Beck, 2010, p. 121). Psychologically a number of studies had identified that immersive SBE evoked fear and anxiety in participants (Bland and Tobbell, 2016; Burbach et al., 2016; Pollock and Biles, 2016). To minimise this potential problem, all facilitators were trained and experienced in SBE and, in particular, the process of debriefing. Thus, a safe learning environment was created that would minimise any potential distress (Rudolph et al., 2014) and, by adopting this ethos in the debrief it would allow participants to explore and make sense of their personal experiences (Jeffries and Rizzolo, 2006; Reed, 2014, p. 125; Sweeney, 2009). I also emphasised that participants could contact me at any point during the study to discuss any concerns or issues they had. The use of SBE technologies also posed a potential risk of physical harm, therefore, I ensured that all local health and safety policies were in place and, up to date, and that all staff were fully proficient in the use of the equipment. To avoid excessive demands on the participants, I established at the start of the study whether they were involved in any other research projects. This also prevented any clashes of interests.

Building on non-maleficence the principle of beneficence moves beyond doing harm to promoting actual good (Cohen et al., 2011, p. 86; Maltby, 2010, p. 348) and, although I led the development and undertook the research I stressed that the benefits of the study extended beyond my studies. I hoped that the findings would inform not only SBE practice within the University but also practice in the wider SBE community and, as a result, add to the body of evidence supporting SBE as a learning and teaching

methodology. As I aimed to disseminate the findings to relevant stakeholders as well as through conference presentations and publications, I outlined this to the participants in the study information.

## **4.9 – Chapter summary.**

This chapter has outlined the various stages in the research process adopted during my study. It started by giving a detailed account of the issues around the choice of method, design and the sampling technique. At this point, the independent and dependent variables were identified and discussed and, the research question and hypotheses articulated. The development of the data collection tools was discussed in depth, including a detailed decision making trail that justified the finalised tools. To end, the chapter covered other methodological considerations such as the ethical underpinnings of the research. The next chapter discusses the data analyses process and outlines the various statistical tests adopted.

# Chapter Five: Data analysis and findings

## 5.1 – Chapter overview

The previous chapter outlined the research process I adopted to explore the impact of the Sim-TDP intervention on the dependent variables compared to a traditional SBE approach. This chapter continues the process by presenting the data from the various statistical tests used and, in the process, providing a rationale for their choice. The statistical tests adopted included a mixed ANOVA, independent and paired *t*-tests and the Mann-Whitney *U* test. A series of multiple regression analyses were also used to identify any predictor variable effects on the dependent variables. The data was analysed following the five phase process outlined by Polit (2010a, p. 14) and assessed for missing data, outliers, bias and for any violations of assumptions. The latter included a) independence, b) additivity and linearity, c) normality, and d) homogeneity of variance/homoscedasticity. As these varied, depending on the actual statistical test used, the chapter presents the data for each of the dependant variables in turn, including the results obtained from each of the three phases. It therefore presents the findings for the participants' performance first, followed by the self-efficacy and finally, the knowledge results.

## 5.2 – Data analysis

The data collected was analysed following the process outlined by Polit (2010a, p. 14) that identified five phases: the pre-analysis phase, preliminary assessments, preliminary actions, principal analyses and the interpretative phase. In the pre-analysis phase, I chose to analyse the data using the software package Statistical Package for the Social Sciences® (SPSS®) (IBM® SPSS® Statistics version 22). The data from the performance, knowledge and self-efficacy tools was then added and coded as discussed previously.

### **5.2.1 - Demographic data**

The demographic data (Table 3) from participants was coded and entered into the SPSS® package. This included the nominal data sets such as the participants gender (Male = 1, and female = 2), age (18 – 24 = 1, 25 – 30 = 2, 31 – 36 = 3, and 37+ = 4) and academic level (Advanced diploma = 1, and degree = 2). It also included which arm they were randomised to (Intervention arm = 2 and the comparison arm = 1) and the group codings. These were the two GT groups in the intervention arm (Blue = 2, and green = 3) and the comparison group (Red = 1, and orange = 4) together with their subgroup designation (A = 1, B = 2, C = 3, and D = 4).

Initially, 98 student nurses from the adult nursing programme were enrolled onto the study; however, at the start of P2, one participant from the intervention arm requested to withdraw from the study and, following the ethical process, all their data was removed. A further four participants left the programme over the course of the study,

leaving a final sample size of 93. Of the original sample (N=98) 3% (n= 3) were male and the remaining 97% (N= 95) were female.

Table 3: Demographic data

			Intervention	Comparison
Participants	Total	98	52 (53%)	46 (57%)
	Withdrew	1	1	0
	Left programme	4	2	2
	Grand total	93	49	44
Gender	Male	3 (3%)	2	1
	Female	95 (97%)	50	45
Age	18-24	73 (76%)	34	39
	25-30	24 (24%)	17	7
	31-36	6 (6%)	5	1
	37 +	8 (8%)	4	4
Academic level	Degree	28 (28%)	28 (28%)	0
	Advanced diploma	70 (72%)	24 (25%)	46 (47%)

The distribution of their ages ranged from 76% (n= 73) of the participants being between 18 and 24 years of age, 10% (n= 10) being between the ages of 25 to 30, 6% (n= 6) being between 31 and 36, and 8% (n= 8) being over 37 years of age. In terms of their academic level of study, 28% (n= 28) were studying at degree level and, due to the randomisation process, were all in the intervention arm. The remaining 72% (n= 70) were studying the advanced diploma option and were split across both arms of the

study with 25% (n= 24) in the intervention arm and the remaining 47% (n= 46) in the comparison arm. Therefore, the participants in the study were predominately below 31 years of age (83%), female (97%) and studying the advanced diploma route (72%).

### **5.2.2 – Diagnostic testing**

A crucial element of the pre-analysis phase was the examination of the data for missing entries and, on inspection, a number of items were missing, which was due to a variety of issues outside my control (Polit, 2010a, p. 14). The first major issue, effecting P2 of the study, occurred when the timetabled session for the green GT group (Intervention arm) was cancelled. This was due to unforeseen external factors, but it meant that all four of the GT sub-groups did not undertake their SBE session. Unfortunately, due to resourcing issues and, the limited availability of SBE suites, this session could not be rescheduled before the participants went on to their clinical placements and, as a result, it exceeded the P2 time frame. This left a considerable gap in the data, which was further compounded when the start of one of the blue sub-groups (P2 - Blue A) was delayed due to one of the participants becoming ill. As a result, the video for this session was only partially captured and could not be used in the analysis. In P3, a technical problem with the video capture system meant that the footage of one of the green sub-groups (P3 – Green C) was not recorded, and once again, this meant that their performance data could not be utilised.

Another element of the pre-analysis phase, outlined by Polit (2010a, p. 14) to be undertaken, was the identification of outliers. As this could potentially bias the data,

especially when there was extreme cases, as they could distort the population distribution and effect the homogeneity of the data set (Tolmie et al., 2011, p. 127). This was undertaken for all the data produced by the knowledge and self-efficacy tools. As the data from the performance tool was based on the consensus marks generated from the two raters and myself, this process would not be appropriate and was therefore not undertaken. Data boxplots were generated to check for outliers (Field, 2013, p. 176) and, once they had been identified, their data entries were then inspected to ascertain the possible cause for this and, if necessary, corrective action was undertaken. Several entries were missing due to errors in the data input, for example, an incorrect code had been entered in the P1 knowledge questionnaire for the intervention arm, which was corrected (Figure 8). In addition, a number of participants did not complete the knowledge questionnaire correctly; for example, the second page on the reverse side of a P1 questionnaire had not been completed, so these and other entries were removed (Figure 9).

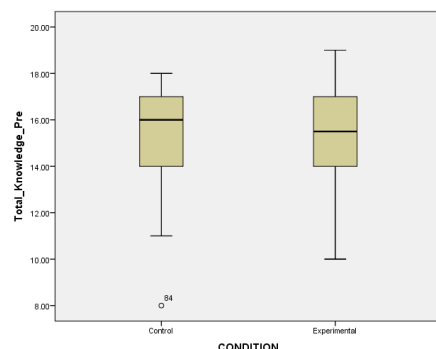


Figure 8: Box plot for P1 knowledge data prior to outlier removal

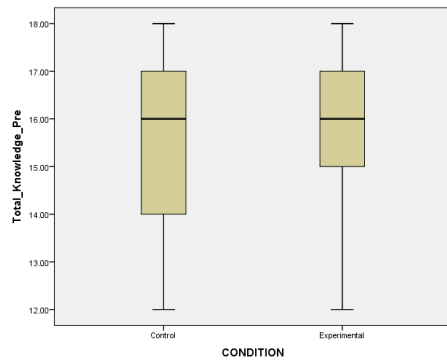


Figure 9: Box plot for P1 knowledge data post outlier removal

In the preliminary assessment and action phases of the analysis process outlined by Polit (2010a, p. 14), the data was further assessed for bias and violations of assumptions. This was important since I was undertaking a number of statistical tests, especially parametric tests, where any violations in the data could lead to inaccurate results and incorrect conclusions (Field, 2013, p. 165). Field (2013, p. 164) described bias as the loss of objectivity in the data analysis. An assumption has been described by a number of authors (Field, 2013, p. 165; Polit, 2010a, p. 102) as a characteristic of the study population that could be accepted as true, but may vary between the statistical test(s) being used; for example, randomisation. Often a common assumption in all the statistical tests (Polit, 2010a, p. 102; Polit and Beck, 2010). As pointed out by Punch (2009, p. 219), randomisation in an education programme was difficult to achieve. So to meet this assumption, reduce bias and maintain the integrity of the quasi-experimental method (Punch, 2009, p. 219) I adopted the approach advocated by Cohen et al. (2011, p. 323) where the natural occurring GT groups were randomly selected.

Other assumptions that had to be assessed for were a) independence, b) additivity and linearity, c) normality, and d) homogeneity of variance/homoscedasticity (Field, 2013, p.



165). Independence meant that the results would only be valid if the data from the study groups was not influenced by the other groups (Field, 2013, p. 176). As the intervention and comparison groups were undertaking their SBE sessions at different dates and, the questionnaires were administered on an individual basis, under examination style conditions, this assumption was met. Linearity meant that a straight line relationship existed between the dependent and independent variables (Field, 2013, p. 167; Polit, 2010a, p. 245) and, when there were several predictor variables their combined effects were additive in nature (Field, 2013, p. 167). Normality referred to the assumption that the dependent variables were normally distributed in the population and, if the mean and the standard deviation of a population were known, then the distribution to the entire population could be inferred (Plichta et al., 2013, p. 69; Polit, 2010a, p. 103). Homogeneity of variance/homoscedasticity donated that the variation in the scores of the dependent variable were equal across all groups being studied (Field, 2013, p. 174; Tolmie et al., 2011, p. 121). A number of tests were available to assess these assumptions, and Field (2013, p. 179) recommended that a researcher should initially use graphs such as histograms and P-P Plots (Probability-probability plots) to visual inspect the data for additivity, linearity and normality. A P-P graph plots the actual z-score of a variable against the expected z-score which, if the data was normally distributed, should be equal.

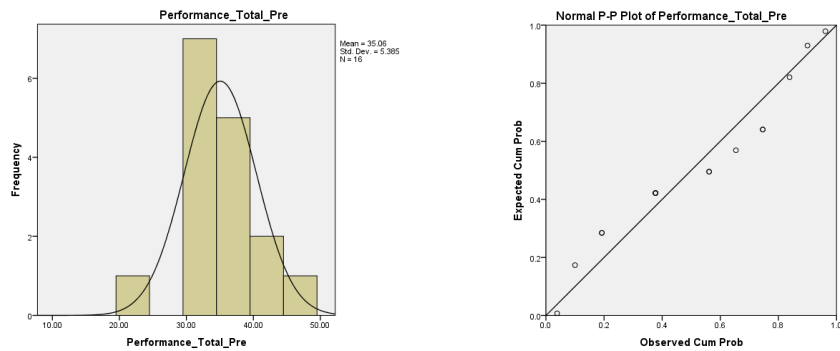
### **5.2.3 - Performance analysis**

#### **5.2.3.1 – Performance data diagnostics**

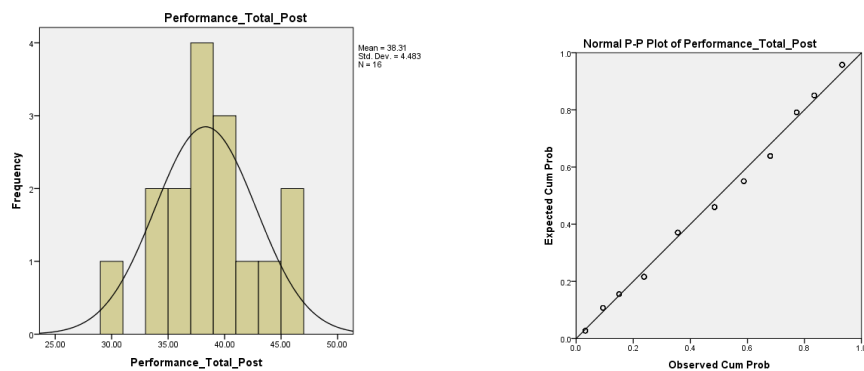
Continuing the preliminary assessment and action phases (Polit, 2010a, p. 14), histograms and probability-probability plots (P-P plot) were produced of the frequency distribution for each of the sub-group's performance scores to check for normality in the scores (Figure 10). Although the P-P plots demonstrated that the scores were linear and, additive in nature, the individual plots appeared to drift from the diagonal line indicating potential problems with skew and kurtosis (Field, 2013, p. 181). The histograms also appeared to have a none normal distribution and, therefore, as advocated by Field (2013, p. 184), further analysis was undertaken to calculate the skewness and kurtosis for the subgroup performance scores across all three phases (Table 4). z-scores were calculated for skewness using the following equation  $z_{\text{skewness}} = (S - 0) / SE_{\text{skewness}}$ , with a value greater than + or - 1.96 being statistically significant at a  $p = <.05$  level. The same procedure was followed to calculate the kurtosis and the subsequent z-score ( $z_{\text{kurtosis}} = (K - 0) / SE_{\text{kurtosis}}$ ), and again, a value greater than + or - 1.96 was statistically significant at a  $p = <.05$  level. In all phases, the pre and post-performance scores did not demonstrate a statistically significant skew or kurtosis except the post-performance scores in P2, which had a statistically significant negative skew. This skew was just above the 1.96 level at -1.97 indicating an accumulation of higher scores from the central mean. A statistically significant positive kurtosis was also evident, which was leptokurtic in nature, indicating a greater number of high scores. This suggested that the post-performance for these phases were not normally distributed and, warranted further investigation and analysis.

Figure 10: Histograms and probability-probability plots (P-P plot) of the frequency distribution of each of the sub-group's performance

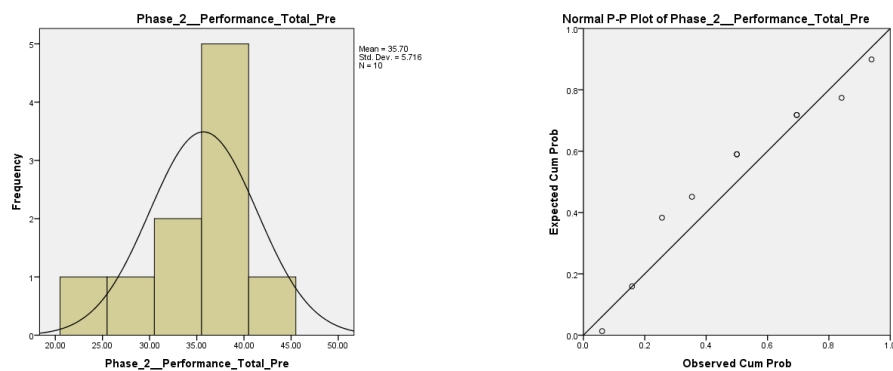
#### Phase 1 pre-performance histogram and P-P plots



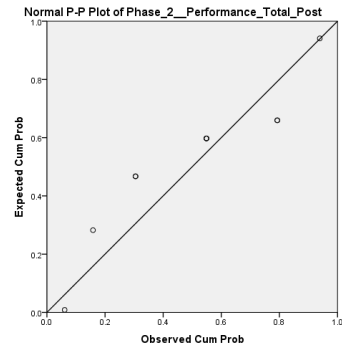
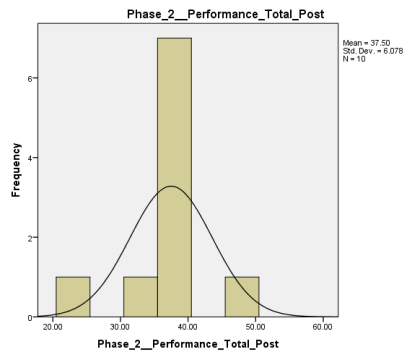
#### Phase 1 post-performance histogram and P-P plots



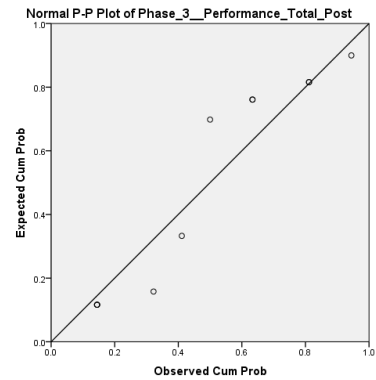
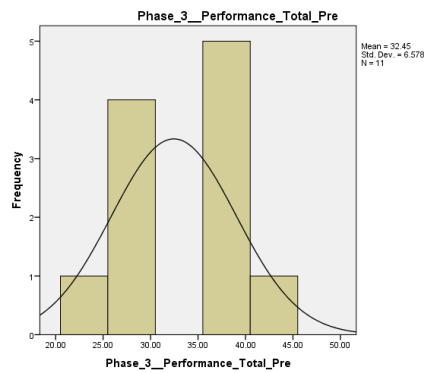
#### Phase 2 pre-performance histogram and P-P plots



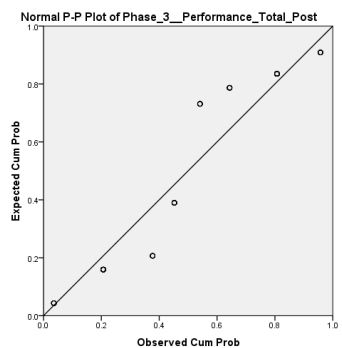
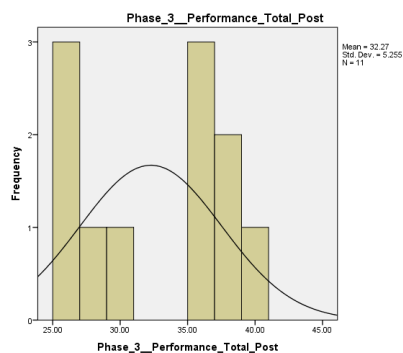
## Phase 2 post-performance histogram and P-P plots



## Phase 3 pre-performance histogram and P-P plots



## Phase 3 post-performance histogram and P-P plots



In light of this, one area that I considered was that of the central limit theorem, which states, that as a sample gets larger the sampling distribution would have a normal distribution with a mean equal to the population mean (Field, 2013, p. 54; Polit, 2010a,

p. 89; Tolmie et al., 2011, p. 120). As discussed by Rodríguez-López and Carrasquillo (2006) in relation to this, a sample size over thirty would produce a distribution of sample means that would be normally distributed and, centred at the population mean.

Table 4: Skewness and kurtosis calculations for the subgroup performance scores						
	Skewness	Standard error of Skewness	Skewness z score	Kurtosis	Standard error of Kurtosis	Kurtosis z score
Phase 1 performance pre	-0.23	0.56	-0.41	2.08	1.09	1.91
Phase 1 performance post	0.16	0.56	0.29	-0.30	1.09	-0.27
Phase 2 performance pre	-1.26	0.69	-1.83	1.90	1.33	1.42
Phase 2 performance post	-1.36	0.69	-1.97	4.07	1.33	3.05
Phase 3 performance pre	0.08	0.66	0.13	-1.00	1.28	-0.78
Phase 3 performance post	-2.18	0.66	-0.33	-2.02	1.28	-1.57

The number of sub-groups in the study was sixteen and, in terms of normality, this was insufficient to assume a normal distribution of the dependent variables under the central limit theorem (Field, 2013, p. 172). As this was not met, a Shapiro-Wilk test was undertaken (Table 5). This test was utilised as it was more sensitive than the Kolmogorov-Smirnov test (Field, 2013, p. 185) and, this analysis identified that both the pre and post scores across all phases were normally distributed.

Table 5 - Shapiro-Wilk tests on performance scores

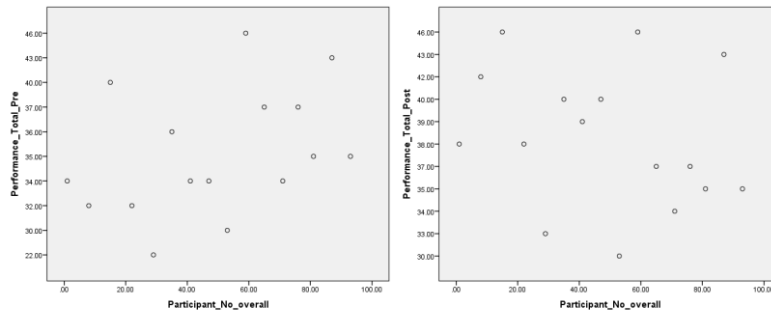
	Shapiro-Wilk		
	Statistic	df	Sig.
Phase 1 performance pre	.97	8	.861
Phase 1 performance post	.96	8	.762
Phase 2 performance pre	.99	8	.990
Phase 2 performance post	.88	8	.198
Phase 3 performance pre	.90	8	.294
Phase 3 performance post	.85	8	.096

In terms of homogeneity of variance/homoscedasticity, the visual inspection the scatter plots demonstrated homogeneity in the P1 plots. However, the P2 plots (Figure 11, c and d) and the P3 plots (Figure 11, e and f) did not demonstrate homogeneity.

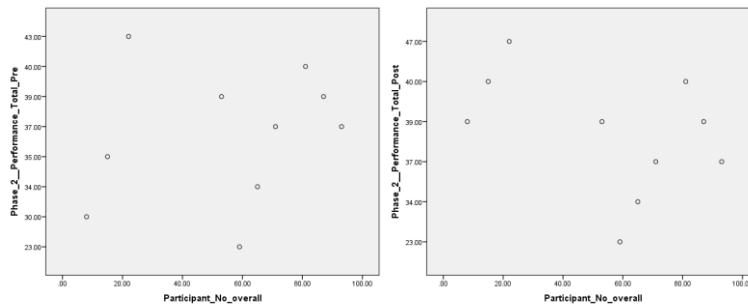
Therefore, this assumption was potentially violated during these phases and required further analysis. A range of tests were used that were specific to the individual statistical test; for example, I used the Levene's test for the independent *t*-test and these will be discussed later in the chapter.

Figure 11: Scatter plots for mean performance scores

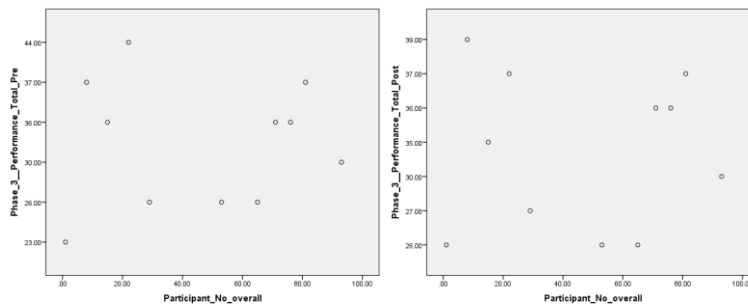
Phase 1 – pre (a) and post-performance (b) scatter plot



Phase 2 – pre (c) and post-performance (d) scatter plot



Phase 3 – pre (e) and post-performance (f) scatter plot



### 5.2.3.2 - Descriptive statistics

Entering the principle analysis phase (Polit, 2010a, p. 14), I performed the descriptive and other statistical analyses on the performance scores. At the sub-group level (N=16), the performance data from each of the three phases was initially analysed to compare the baseline means in the groups pre-performance scores, for both the intervention arm (n= 8) undertaking the Sim-TDP intervention and, those in the comparison arm (n= 8) undertaking the traditional SBE approach (Table 6).

Table 6: Pre/post-performance group statistics				
	Condition	Group statistics		
		n	Mean	SE
Phase 1 performance pre	Comparison	8	37.13	1.81
	Intervention	8	33.00	1.81
Phase 1 performance post	Comparison			
	Intervention	8	39.50	1.31
Phase 2 performance pre	Comparison	7	35.57	2.22
	Intervention	3	36.00	3.79
Phase 2 performance post	Comparison			
	Intervention	3	42.00	2.52
Phase 3 performance pre	Comparison	6	31.83	2.10
	Intervention	5	33.20	3.84
Phase 3 performance post	Comparison			
	Intervention	5	32.80	2.65



### 5.2.3.3 – *t*-tests and Mann-Whitney *U* tests on sub-group performance level

#### 5.2.3.3.1 - Phase 1 analysis

In phase 1, the mean scores in the base line pre-performance SBE were higher in the comparison arm ( $n = 8$ ,  $M = 37.13$ ,  $SE = 1.81$ ) than those in the intervention arm ( $n = 8$ ,  $M = 33.00$ ,  $SE = 1.81$ ). This then reversed in the post-intervention performance SBE scores with the intervention groups having a higher mean score ( $n = 8$ ,  $M = 39.50$ ,  $SE = 1.31$ ) than the traditional SBE comparison group ( $n = 8$ ,  $M = 37.13$ ,  $SE = 1.81$ ). This difference in the mean scores warranted further statistical analysis and, when comparing the means of two groups, a number of authors (Adamson and Prion, 2014b; Cohen et al., 2011, p. 642; Field, 2013, p. 364; Plichta et al., 2013, p. 93; Polit and Beck, 2010, p. 413) advocated the use of the independent *t*-test. As Plichta et al. (2013, p. 93) advised, the test variable should be the dependent variable (the pre and post-performance scores), and the grouping variable should be the independent variable (the comparison and intervention arms).

To undertake this test, a number of assumptions had to be met in addition to the assumptions of randomisation, independence, additivity, linearity, and normality (Field, 2013, p. 165). This included the level of measurement of the variables (Polit, 2010a, p. 116). The independent variable was a dichotomous nominal level variable and the dependent variable was measured at an interval or ratio level. In P1, these assumptions were met, but in terms of the assumption of homogeneity of variance/homoscedasticity a Levene's test had to be undertaken. This tests the null hypothesis that the variances in both groups was equal (Polit, 2010a, p. 120). This analysis was not statistically significant, therefore, equal variance was assumed and

the null hypothesis that both groups were equal was accepted (Cohen et al., 2011, p. 642). I was, therefore, able to proceed with the analysis.

The independent  $t$ -test on the pre-performance scores between the comparison arm ( $M = 37.13$ ,  $SE = 1.81$ ) and, the intervention arm ( $M = 33.00$ ,  $SE = 1.81$ ) with a mean difference of 4.12, 95% CI (-1.36, 9.61), found no statistically significant difference ( $t_{(14)} = 1.61$ ,  $p = .129$ ). A similar result was found in the post-performance scores between the intervention group ( $M = 39.50$ ,  $SE = 1.31$ ) and the traditional SBE comparison group ( $M = 37.13$ ,  $SE = 1.81$ ), with a mean difference of -2.38, 95% CI (-7.16, 2.41), which was not statistically significant ( $t_{(14)} = -1.06$ ,  $p = .305$ ). Even though the post-performance mean score of the intervention group was greater, it was not statistically significant. Inferring that Sim-TDP during this individual phase did not have an effect on performance. However, as Field (2013, p. 376) recommended, even though the  $t$ -statistic was not significant in practical terms it does not mean that this was not important in the context of the study and he recommended calculating the effect size.

As Field (2013, p. 79) argued, statistical significance itself does not convey the importance of a test and, recommended that effect size should also be calculated to measure the strength of the relationship between variables. This point was echoed by Polit (2010a, p. 126), who highlighted the importance of considering effect size and probability levels when interpreting results. As an index that quantifies the degree to which the results of a study should be considered, it provides a useful indicator of the practical importance of research results (Hojat and Xu, 2004). The effect size classification of Cohen's  $d$  developed by Cohen (1988, pp. 25-26), has been recognised as a common statistical test used to calculate the effect size (Hojat and Xu, 2004). This calculates the size by dividing the mean of the two groups by their pooled standard deviations (Adamson and Prion, 2013a). Cook et al. (2012) in a systematic

review, comparing technology-enhanced SBE training with no SBE instruction, used effect sizes to determine the comparative effectiveness of SBE. They used the Cohen's *d* classification that acknowledged < 0.2 as a negligible effect, 0.2-0.49 a small effect, 0.5-0.8 as a moderate effect and > 0.8 a large effect size. Cook et al. (2012) found that this was an effective measure to determine the value of an intervention. Therefore, this was adopted and, throughout the study the relevant effect sizes subsequently reported. When calculated on the post-performance scores, this demonstrated that the intervention had a moderate effect size ( $d = 0.53$ ) on the groups. Thus inferring that the Sim-TDP intervention during this individual phase had an impact, although moderate, on performance.

As the change in mean scores of the sub-groups had a moderate effect size, this was explored further using a paired *t*-test. This was a within-group design used to analyse the difference between the means of the same group of participants at two different points in time (Cohen et al., 2011, p. 642; Field, 2013, p. 364; Polit, 2010a, p. 121). This was only undertaken on the sub-groups of the intervention arm as the comparison arms performance was only captured once per phase. The mean post-performance score of the intervention sub-groups ( $M = 39.50$ ,  $SE = 1.31$ ) was higher than their mean pre-performance score ( $M = 33.00$ ,  $SE = 1.81$ ) and, had a mean difference of -6.05, 95% CI (-8.70, -4.31), which was statistically significant ( $t_{(7)} = -7.02$ ,  $p = <.001$ ). The effect size was very large ( $d = 1.45$ ). Thus inferring that the Sim-TDP intervention, during this individual phase, enhanced the performance of the intervention groups.

Due to potential violation of assumptions related to normality and homogeneity of variance/homoscedasticity in P2, I maintained parity between the analyses of all phases by undertaking a non-parametric test (Tolmie et al., 2011, p. 128). I used the Mann-Whitney *U* test as it provided a powerful non-parametric test that was equivalent

to the independent *t*-test and, could be used when the dependent variable was measured at an ordinal level and when the assumptions of a parametric test had not been met (Cohen et al., 2011, p. 655; Pett, 2016, p. 177; Polit, 2010a, p. 180). I also used it to test the null hypothesis that the two population distributions were equal (Plichta et al., 2013, p. 111), as it has particularly strong power when the alternative hypothesis states that the distribution between the two groups was the same (Pett, 2016, p. 177). The Mann-Whitney *U* test used the relative ranks of the scores in each group (Plichta et al., 2013, p. 117; Tolmie et al., 2011, p. 128) and, as such it overcame the problems encountered in parametric tests related to the violation of assumptions (Field, 2013, p. 214). The Mann-Whitney *U* test was, therefore, performed on the P1 performance data with the pre and post-performances scores as the test variables and the comparison and intervention arms as the grouping variables. This revealed no statistically significant differences in the mean rank scores between the comparison arm and the intervention arms pre-performance ( $U = 16.50$ ,  $z = -1.64$ ,  $P = .100$ ) and their post-performance ( $U = 19.50$ ,  $z = -1.32$ ,  $P = .188$ ). These findings were congruent with the results from the independent *t*-test.

#### **5.2.3.3.2 - Phase 2 analysis**

In phase 2 (P2), the review of the descriptive statistics revealed that the base line pre-performance mean scores for the comparison arm ( $n = 7$ ,  $M = 35.57$ ,  $SE = 2.22$ ) were lower than those in the intervention arm ( $n = 3$ ,  $M = 36.00$ ,  $SE = 3.79$ ). This pattern continued when the post-performance scores of the intervention groups ( $n = 3$ ,  $M = 42.00$ ,  $SE = 2.52$ ) were compared to the traditional SBE comparison groups ( $n = 7$ ,  $M = 35.57$ ,  $SE = 2.22$ ). These were once again analysed using an independent *t*-test, for both pre and post-performance mean scores. In terms of the assumption of homogeneity of variance/homoscedasticity, a Levene's test was undertaken. This test

was not statistically significant, therefore, equal variance was assumed and the null hypothesis that both groups were equal was accepted. The analysis of the pre-performance scores of the comparison arm ( $M = 35.57$ ,  $SE = 2.22$ ) and the intervention arm ( $M = 36.00$ ,  $SE = 3.79$ ) did find a mean difference of  $-4.13$ , 95% CI  $(-10.07, 9.21)$  but, this was not statistically significant ( $t_{(8)} = -.10$ ,  $p = .921$ ). In the post-performance scores between the intervention sub-groups ( $M = 42.00$ ,  $SE = 2.52$ ) and the comparison sub-groups ( $M = 35.57$ ,  $SE = 2.22$ ) the analyse found a mean difference of  $-6.43$ , 95% CI  $(-15.25, 2.39)$ , but once again, this was not statistically significant ( $t_{(8)} = -1.68$ ,  $p = .131$ ). As in P1, the effect size was calculated using the Cohen's  $d$  statistical test on the post-performance scores, which demonstrated that the intervention had a large effect size ( $d = 1.24$ ) on the groups. Inferring that, even though the findings were not statistically significant, the Sim-TDP intervention, due to the large effect size, had the potential, in the context of an educational intervention, to enhance performance.

Due to this large effect size, a paired  $t$ -test was performed on the mean scores of the intervention sub-groups. The mean post-performance score of the intervention sub-groups ( $M = 42.00$ ,  $SE = 2.52$ ) was higher than their mean pre-performance score ( $M = 36.00$ ,  $SE = 3.79$ ) and had a mean difference of  $-6.00$ , 95% CI  $(-12.57, 0.57)$ , which was not statistically significant ( $t_{(2)} = -3.93$ ,  $p = .059$ ). The effect size of this was also large ( $d = 1.08$ ). Once again inferring that even though the findings were not statistically significant the Sim-TDP intervention, due to the large effect size, had the potential, in the context of an educational intervention, to enhance performance.

Although the  $t$ -test was fairly robust to violations in normality (Polit, 2010a, p. 116) it relied on a large sample size and, one that was greater than thirty (Plichta et al., 2013, p. 96). As a result of the loss of data to external factors, I undertook a non-parametric test since it did not rely on the assumptions that needed to be met in the parametric

tests (Field, 2013, p. 214). This test revealed no statistically significant difference in the mean rank scores between the comparison arm and the intervention arm pre-performance ( $U = 10.00$ ,  $z = -.12$ ,  $P = .909$ ), and their post-performance ( $U = 2.50$ ,  $z = -1.86$ ,  $P = .063$ ) scores. These findings were congruent with the results from the independent  $t$ -test.

#### **5.2.3.3.3 - Phase 3 analysis**

In phase 3 (P3), the review of the descriptive statistics revealed that the pre-performance mean scores for the intervention sub-groups ( $n = 5$ ,  $M = 33.20$ ,  $SE = 3.84$ ) were higher than those in the comparison sub-group ( $n = 6$ ,  $M = 31.83$ ,  $SE = 2.10$ ). This pattern continued with the post-performance scores with the intervention arm scores remaining higher ( $n = 5$ ,  $M = 32.80$ ,  $SE = 2.65$ ) than the groups in the comparison arm ( $n = 6$ ,  $M = 31.83$ ,  $SE = 2.10$ ). What was evident was that the scores for both arms were lower than their pre-performance scores and, this indicated a fall overall in their scores post intervention. These were analysed using an independent  $t$ -test and, once again, a Levene's test was undertaken, which was not statistically significant, therefore, equal variance was assumed. In the pre-performance scores of the comparison arm ( $M = 31.83$ ,  $SE = 2.10$ ) and the intervention arm ( $M = 33.20$ ,  $SE = 3.84$ ) the analysis found a mean difference of  $-1.37$ , 95% CI  $(-10.81, 8.08)$ , which was not statistically significant ( $t_{(9)} = -.33$ ,  $P = .751$ ). In the post-performance scores between the intervention sub-groups ( $M = 32.80$ ,  $SE = 2.65$ ) and the comparison sub-groups ( $M = 31.83$ ,  $SE = 2.10$ ) the analysis found a mean difference of  $-0.97$ , 95% CI  $(-8.51, 6.59)$ , which was also not statistically significant ( $t_{(9)} = -.29$ ,  $P = .779$ ). As with the other phases, the effect size was calculated and this demonstrated that the intervention had a very small effect size ( $d = 0.17$ ). Inferring that Sim-TDP during this individual phase did not have an effect on performance.

A paired  $t$ -test was also performed on the intervention arm sub-groups mean scores. The mean post-performance score of the intervention sub-groups ( $M = 32.80$ ,  $SE = 3.84$ ) was lower than their mean pre-performance score ( $M = 33.20$ ,  $SE = 3.79$ ) and had a mean difference of 0.40, 95% CI (-4.54, 5.34), which was not statistically significant ( $t_{(4)} = 0.23$ ,  $p = .833$ ). The effect size of this was negligible ( $d = 0.05$ ). Once again inferring that Sim-TDP during this individual phase did not have an effect on performance.

In P3, all assumptions were met but as in P1, a Mann-Whitney  $U$  test was undertaken to maintain parity between the phases. This revealed no statistically significant difference in the mean rank scores between the comparison arm and the intervention arms pre-performance ( $U = 13.50$ ,  $z = -.28$ ,  $P = .780$ ) and post-performance ( $U = 12.50$ ,  $z = -.46$ ,  $P = .644$ ). These findings were congruent with the results from the independent  $t$ -test.

Overall, in terms of performance during the individual phases, there was no statistically significant differences between the intervention and the comparison groups during any of the individual phases inferring that Sim-TDP during this individual phase did not have an effect on performance. However, there appeared to be a trend in the effect sizes, which increased between P1 and P2, before levelling off in P3, a phenomena that was apparent on the intervention groups paired  $t$ -test scores.

#### **5.2.3.4 - All phases Mixed ANOVA**

To optimise the use of DP, an educational programme needed to include immediate feedback, reflection, correction further opportunities to rehearse these skills (Ericsson, 2008; Ericsson et al., 1993). Therefore, I reasoned that Sim-TDP was time dependent and, that I needed to test this at set points over the course of the study. To test the mean scores of different groups at multiple points during a single analysis, Polit (2010a, p. 151) and Adamson and Prion (2014a) recommended the use of the analysis of variance (ANOVA) technique. This tested the differences between the means of three or more groups on a dependent variable, which was measured for each person in each group (Polit and Beck, 2010, p. 415; Punch and Oancea, 2014, p. 314). The null hypothesis of an ANOVA test was similar to that of a *t*-test, where the difference between the population means of the groups were equal. The alternative hypothesis would, therefore be, that there was a difference between the groups (Polit, 2010a, p. 138).

Using the ANOVA technique, the difference in the mean scores both within each of the groups (the within-subject factor) and, between them (the between-subject factor) would be calculated. In doing so, this determined the *F* – ratio, which was the ratio between the between-group variation and the within-group variation (Cohen et al., 2011, p. 630; Harris et al., 2012; Polit, 2010a, p. 141). In my study, the dependent variables, or factors, such as performance, knowledge and self-efficacy represented the within-subject factors and, the two independent factors, the intervention arm and the comparison arm represented the between-subject factors. When the *F* - ratio was calculated it was compared to a set of critical values that were based on a set level of significance (Harris et al., 2012).



In exploring the use of the ANOVA method, I found that there was a number of approaches that could be used depending on the study design. These included a one-way ANOVA with repeated measures, a two-way ANOVA with repeated measures or a mixed ANOVA (Polit and Beck, 2010, p. 416; Punch and Oancea, 2014, p. 314; Tolmie et al., 2011, p. 263). As the single dependent variable or factor (either performance, knowledge or self-efficacy) was measured at six different points in time it represented the within-subjects factor and, met the criteria for a repeated measures design. However, as there were two independent factors (the intervention group and the comparison group) that reflected the between-subjects factors Cohen et al. (2011, p. 648) and Plichta et al. (2013, p. 185) recommended using a two-way (two factor) analysis with repeated measures. This would mean that the participants would have to undertake both the intervention and the comparison elements of the study (Polit, 2010a, p. 146), which in practical terms was unachievable, so this approach did not fit the study design. Field (2013, p. 592), however, recommended that when there was a combination of repeated measures and independent designs a mixed ANOVA should be used. Therefore, I adopted this approach.

This statistical test was also appropriate when the dependent variable was measured at an interval or ratio level and, when the independent variable was measured at a nominal level (Polit, 2010a, p. 138) The study, therefore, met these criteria. As in other parametric tests, the assumptions needed to be met were randomisation, normality and homogeneity of variance/homoscedasticity (Field, 2013, p. 593; Polit, 2010a, p. 139). Randomisation was undertaken and, in terms of normality, the Shapiro-Wilk test demonstrated that this was met. As Polit (2010a, p. 139) discussed, an ANOVA was robust with regard to the last two assumptions, especially if the group sizes were equal to or greater than twenty (Field, 2013, p. 444; Plichta et al., 2013, p. 189).

Unfortunately, the number of subgroups in the study fell below this number and, in terms of homogeneity of variance/homoscedasticity, this was insufficient to meet this criteria. As there was a potential violation in the performance scores a Levene's test would have to be performed to test for any violations. Unfortunately, if there were violations there were no non-parametric equivalent tests that could be utilized in this situation (Field, 2013, p. 593) and, this would have to be acknowledged during the study.

Nevertheless, to assess the effect of the Sim-TDP intervention on the performance scores over time, the mixed ANOVA design was undertaken using the sub-groups pre and post-performance scores as the within-group variable and, the two conditions (intervention and comparison) as the between-subject variables. Initially, the baseline pre-performance scores of both the intervention and comparison subgroups were analysed and this identified that there were no statistically significant difference in the mean scores  $F_{(1, 6)} = 1.41, p = .281$  (Figure 12). As in the *t*-test analysis, the effect size was also explored. In SPSS® the magnitude of the relationship between the dependent and independent variables could be assessed using partial Eta<sup>2</sup> ( $\eta_p^2$ ) (Polit, 2010a, p. 158; Tolmie et al., 2011, p. 269). However, this measure had the potential to be misleading as it was accumulative in nature and, when reported, could give figures over 100%. Consequently, I used Pearson's correlation coefficient *r*, as recommended by Field (2013, p. 616), since this analysis provided the strength of the relationship between variables whilst estimating the effect size (Field, 2013, p. 82; Hojat and Xu, 2004). To calculate *r* the following equation was used:

$$r = \sqrt{\frac{F(1,df_R)}{F(1,df_R)+df_R}}$$

This yielded an  $r^2$  value of 0.44, which demonstrated a moderate effect size. A power analysis was also undertaken to estimate the probability of correctly rejecting the null hypothesis (Polit, 2010a, p. 160), and the observed power was .17, which was low. Inferring that Sim-TDP did not have an effect, overtime, on pre-performance scores of the participants.

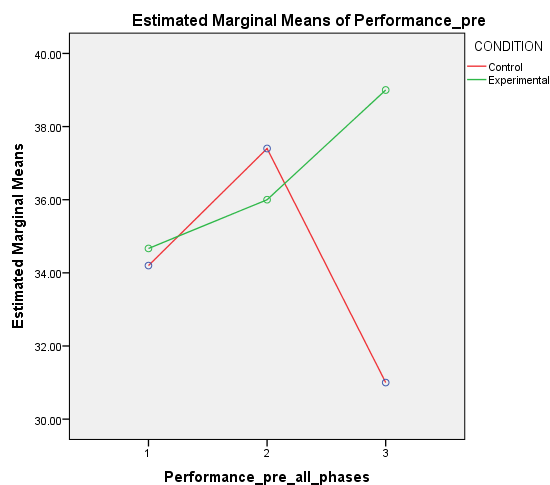


Figure 12: Mixed ANOVA, pre-performance scores

In terms of the assumption of homogeneity of variance/homoscedasticity, a Levene's test was undertaken and this analysis did not demonstrate any statistical significance, therefore, equal variance was assumed (Cohen et al., 2011, p. 642). Another test that needed to be undertaken was Mauchly's test (Plichta et al., 2013, p. 230). I used this test to check the additional assumption with repeated measures ANOVA designs, the sphericity of the data (Polit, 2010a, p. 287). This assumption states that the variance in

the group scores for any two time periods would be the same as the variance for any other period and, the Mauchly's test assessed the hypothesis that the variance of the differences between the conditions was equal (Field, 2013, p. 545; Polit, 2010a, p. 153). This was not statistically significant, therefore, the assumption of sphericity had been met.

A further analysis was undertaken to compare the mean scores of the intervention arm following the Sim-TDP intervention with the baseline mean scores of the comparison arm. This analysis found a statistically significant difference  $F_{(1, 6)} = 19.12$ ,  $p = .005$ , a large effect size  $r^2 = .87$  and, also a large observed power .95 (Figure 13). Both the Mauchly and Levene's tests were not statistically significant. Inferring that Sim-TDP had an effect, overtime, on post-performance scores of the participants, a key element of DP.

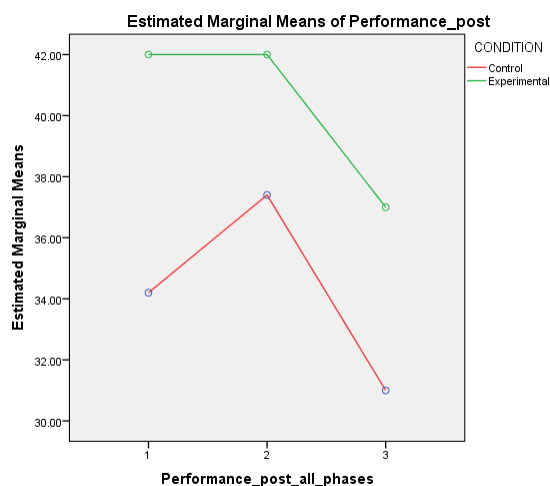


Figure 13: Mixed ANOVA, post-performance scores

### 5.2.3.5 - Multiple regression

As the mixed ANOVA demonstrated that the mean scores of the intervention arm were higher following their Sim-TDP intervention, which was statistically significant, I aimed

at exploring what variables had potentially caused this effect on the post-performance scores. Linear regression analysis has been used to explore and analyse the relationship between variables and, then make predictions about their values and outcomes (Freeman and Walters, 2010, p. 469; Plichta et al., 2013, p. 340). This technique, therefore, offered a suitable method to explore the effect of the variables within the study. In linear regression analysis a straight line, the regression line, represents the least variation in the observed data, or the line of best fit (Cohen et al., 2011, p. 661). As this line runs through the centre of the data denoting the predicted scores, it uses the least square method to calculate the variation in the actual observed data and the regression line to determine the error in the prediction, which was the deviation in scores or residual variation (Plichta et al., 2013, p. 342; Tolmie et al., 2011, p. 102). This then modelled the effects of the independent or predictor variables on the dependent variable (Tolmie et al., 2011, p. 106).

As I was using more than two independent variables to predict their effect on the dependent variable this was classed as a multiple regression analysis (Cohen et al., 2011, p. 663; Polit and Beck, 2010, p. 422) and, I used the following equation to calculate the relationship between the variables:

$$Y' = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + \dots b_kX_k$$

Where:

$Y'$  = Predicted value of the dependent variable  $Y$

$b_0$  = intercept constant

$b_n$  = slope of the regression line

$X$  = actual value of the independent variable  $X$

As the individual post-performance data of the intervention and comparison arms of the study had previously been assessed for bias and potential violations I undertook the multiple regression analysis on the sub-groups post-performance scores.

#### **5.2.3.5.1 - Multiple regression – sub-group post-performance scores**

##### **5.2.3.5.1.1 - Phase 1 analysis**

The dependent variable entered was the P1 post-performance sub-group mean scores and, the SBE based independent, predictor variables, were also entered, see below.

The scenario variables were included to assess the mean effect of the scenarios across the study population. The number of predictor variables was based on the recommendation by Field (2013, p. 313) which, was that there should be in the region of one predictor variable for every ten cases. Therefore, in this study approximately two predictor variables were used, which were:

- Study predictors
  - Condition, with the dummy variables of:
    - Intervention arm
    - Comparison arm (Baseline)
  - Scenario, with the dummy variables of:
    - Hypovolaemia (Baseline)
    - Asthma

When there were violations of assumptions, Field (2013, p. 199) recommended the use of the bootstrap method as this can overcome these by estimating the properties of the

sampling distribution from the sample data. This process involved taking samples of the scores from the study population, a bootstrap sample, and randomly repeating them between 1000 and 2000 times (Field, 2013, p. 199). On completion, the analysis identified that the model did not have a good fit as it had an  $F$  statistic of  $F_{(2, 13)} = 2.45$ . This was the ratio of the variability in the scores that could be explained by the model to the residuals in the model that it could not explain (Field, 2013, p. 302). This was also not statistically significant ( $p = .125$ ), with 16% ( $R^2 = .27$ ,  $Adj R^2 = .16$ ) of the change in scores was being predicted by the model.  $R^2$  represented the percentage of variation in the dependent variable that was explained by the model from the study sample (Field, 2013, p. 302; Polit, 2010a, p. 214), with the adjusted  $R^2$  representing the variation in the model if the data had been taken from the broader population (Field, 2013, p. 321), a more accurate measure (Cohen et al., 2011, p. 662; Polit, 2010a, p. 228).

Using the Beta coefficients (Table 7) that represented the slope of the regression line (Plichta et al., 2013, p. 342; Tolmie et al., 2011, p. 102) with the comparison group as the baseline for the regression coefficients the findings showed that both the standardised beta ( $\beta = .27$ ) and unstandardized beta ( $\beta = 2.38$ ) of the intervention variable did not have a statistically significant effects on the post-performance scores of the participants ( $p = .256$ ). These were calculated using a  $t$ -test to test the null hypothesis that the value of  $b$  ( $\beta$ ) was equal to 0 and, if it was significant, the predictor variable contributed significantly to the predicted outcomes (Field, 2013, p. 303). In contrast to the comparison sub-groups, an increase of 2.38 in the unstandardized Beta of the intervention sub-groups was evident. Using the hypovolaemia scenario as the baseline the scenario predictor variables, did not have any statistically significant Beta coefficients. The asthma scenario in relation to the baseline hypovolaemia scenario, however, caused a 3.88 increase in the unstandardized Beta coefficient, which

demonstrated a positive impact on the predicted scores. This was supported on secondary analysis, as the scenario variables had statistically significant correlations. The asthma scenario had a moderate positive correlation ( $r = .45, p = .042$ ), whilst the hypovolaemia scenario had a moderate negative correlation ( $r = -.45, p = .042$ ) with the sub-group post-performance scores.

As recommended by Field (2013, p. 325), the data was assessed for multicollinearity, which would occur when the independent variables were too highly intercorrelated (Polit, 2010a, p. 245). This could lead to an increase in the error related to the Beta coefficients and reduce the effect of  $R^2$  (Field, 2013, p. 325; Polit, 2010a, p. 245). However, as there were only two predictor variables this test was not undertaken and, therefore, I did not calculate the variance inflation factors (VIF) and tolerance statistic. I also undertook the Durbin-Watson calculation to assess for the assumption of independent errors. This was where no correlation in the residuals of the independent variables existed and, that they were independent of each other (Field, 2013, p. 311). The test yielded a result of  $d = 2.31$ , which was above the lower threshold of 1.0 and below the upper threshold of 3, therefore, identifying that the assumption of independent errors had been met and autocorrelation was not present, which if present could have led to potential bias within the results (Field, 2013, p. 311).

Overall, when working in teams, the findings inferred that Sim-TDP, traditional SBE or the type of scenario did not have effect on the participant's performance. However, the intervention and the asthma scenario did appear to increase the scores of the participants and, additionally, there did appear to be a positive correlation between the latter and the team's scores, although this was not causal.



Table 7: Phase 1 Beta coefficients, multiple regression – sub-group post-performance scores								
Predictor	Beta	SE B	$\beta$	t - Test	P	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	37.56 (34.13 – 40.50)	1.63		21.14	.001			
Intervention	2.38 (1.38 - 5.92)	1.95	.27	1.16	.256	.27	-	-
Asthma scenario	3.88 (.15 -7.73)	1.97	.45	1.89	.092	.45	-	-
$R^2 = .27$ , Adj $R^2 = .16$								
<i>P values, confidence intervals and standard errors based on 1000 bootstrap samples</i>								

### 5.2.3.5.1.2 - Phase 2 analysis

In P2, the dependent variable entered was the P2 sub-group post-performance mean scores with a number of SBE based independent variables also entered. I also included the scenario variables and the P1 total post-performance scores to assess the mean effect of these predictor variables across the study population. The variables were:

- Study predictors
  - Condition, with the dummy variables of:
    - Intervention arm
    - Comparison arm (Baseline)
  - Performance predictor
    - Phase 1 total post scores
  - Scenario predictors, with the dummy variables of:

- Sepsis
- Chest (Baseline)

Due to the potential violation of assumptions, a bootstrap method was, once again, adopted (Field, 2013, p. 199). The model generated did not have a good fit, as it had an  $F$  statistic of  $F_{(3, 6)} = 4.02$ , which was not statistically significant ( $p = .069$ ), and demonstrated that 50% ( $R^2 = .67$ ,  $Adj R^2 = .50$ ) of the change in scores was predicted by the model. The intervention ( $\beta = .88$ ) did not have a statistically significant effect on the P2 post-performance scores of the groups ( $p = .157$ ). Although when compared to the baseline comparison groups an increase of 11.01 was found, which was also greater than the P1 increase in the unstandardized Beta coefficient. The other predictor variables did not have any statistically significant Beta coefficients or any statistically significant correlations (Table 8).

Predictor	Beta	SE B	$\beta$	$t$ - Test	$P$	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	59.67 (32.61 – 91.61)	17.11		5.10	.002			
Intervention	11.01 (.82 – 18.74)	4.53	.88	3.19	.157	.75	.73	1.37
P1 total post-performance	-.68 (-1.52 – .56)	.47	-.61	-2.27	.386	-.54	.77	1.30
Sepsis scenario	3.06 (-5.61 - 14.00)	4.53	.24	.91	.500	.21	.77	1.29
$R^2 = .67$ , $Adj R^2 = .50$								
<i>P values, confidence intervals and standard errors based on 1000 bootstrap samples</i>								

In relation to the baseline chest pain scenario, the sepsis scenario caused a 3.06 increase in the unstandardized Beta coefficient. All Beta coefficients had a low collinearity since they had variance inflation factors (VIF) above 1 and well below 10 and, their tolerance statistic was above 0.2. A Durbin-Watson calculation was  $d = 1.31$ , which was above the lower threshold of 1.0 and above the upper threshold of 3; therefore, the assumption of independent errors had been met and autocorrelation was not present. Overall, when working in teams, the findings inferred that Sim-TDP, traditional SBE or the type of scenario did not have effect on the participant's performance. However, the Sim-TDP and the sepsis scenario did appear to increase the scores of the participants.

#### **5.2.3.5.1.3 - Phase 3 analysis**

In P3, the dependent variable entered was the post-performance mean scores of the sub-groups together with a number of SBE based independent variables. The scenario variables and the P2 total post-performance scores were included to assess the mean effect of these predictor variables across the study population. The variables were:

- Study predictors
  - Condition, with the dummy variables of:
    - Intervention arm
    - Comparison arm (Baseline)
  - Performance predictor
    - Phase 2 total performance score post
  - Scenario predictors, with the dummy variables of:
    - Myocardial Infarction (Baseline)
    - Anaphylaxis

Once again due to potential violation of assumptions, a bootstrap method was adopted using 1000 samples (Field, 2013, p. 199). The model generated did not have a good fit as it had an  $F$  statistic of  $F_{(3, 4)} = 4.53$ , which was not statistically significant ( $p = .089$ ), and overall, demonstrated that 60% ( $R^2 = .77$ ,  $Adj R^2 = .60$ ) of the change in scores was predicted by the model. The intervention did not have a statistically significant effect on the P3 post-performance scores ( $p = .246$ ). Although in contrast to the baseline comparison groups, it did demonstrate an increase of 5.87 in the unstandardized Beta coefficient. The other predictor variables did not have any statistically significant Beta coefficients (Table 9) or any statistically significant correlations. The anaphylaxis scenario in relation to the baseline myocardial infarction scenario caused a 6.56 increase in the unstandardized Beta coefficient. This was also supported by the secondary analysis, which revealed that a number of predictors had statistically significant correlations with the sub-groups mean post-performance scores.

Table 9: Phase 3 Beta coefficients, multiple regression – sub-group post-performance scores								
Predictor	Beta	SE B	$\beta$	$t$ - Test	$P$	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	35.42 (-60.67 – 95.00)	42.51		2.00	.230			
Intervention	5.87 (-9.33 – 13.52)	6.06	.59	1.87	.246	.45	0.59	1.73
Anaphylaxis scenario	6.56 (-2.00 – 12.50)	5.22	.66	2.56	.223	0.61	0.87	1.16
P2 performance total post	-.07 (-0.59 – 0.01)	1.05	-.05	-.15	.896	-.04	.52	1.92
$R^2 = .77$ , $Adj R^2 = .60$								
<i>P values, confidence intervals and standard errors based on 1000 bootstrap samples</i>								

The anaphylaxis scenario had a large positive correlation ( $r = .68$ ,  $p = .032$ ), whilst the myocardial infarction scenario had a large negative correlation ( $r = -.68$ ,  $p = .032$ ). All Beta coefficients had a low collinearity as the variance inflation factors (VIF) were above 1 and well below 10 and, the tolerance statistic was above 0.2. The Durbin-Watson calculation was  $d = 2.14$ , which was above the lower threshold of 1.0 and above the upper threshold of 3; therefore, the assumption of independent errors had been met and autocorrelation was not present. Overall, when working in teams, the findings inferred that Sim-TDP and the type of scenario, anaphylaxis, did have effect on the participant's performance, in addition, there did appear to be a positive correlation with latter and the team's performance, although this was not causal.

#### **5.2.3.5.2 - Multiple regression on the individual participant post-performance scores**

The sub-group analysis of post-performance data did not identify any statistically significant predictors so a further multiple regression analysis was undertaken on the post-performance scores of the participants in both arms of the study ( $N = 93$ ). As the individual post-performance data of the intervention and comparison arms of the study had not been assessed for bias and violation of assumptions I undertook an analysis to assess for additivity and linearity, normality, and homogeneity of variance/homoscedasticity.

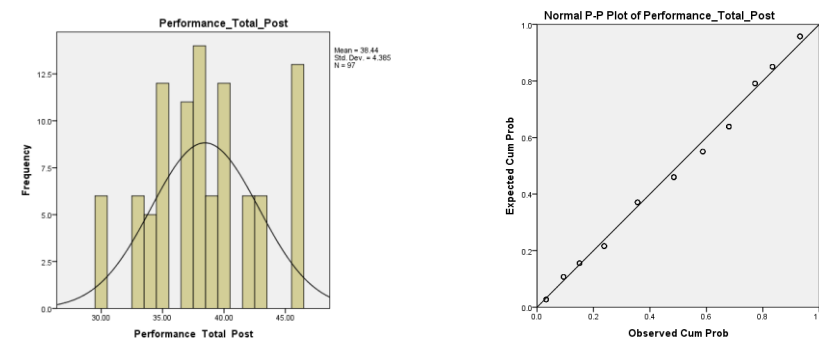
##### **5.2.3.5.2.1 - Diagnostics**

The histogram and probability-probability plots (P-P plot) of the frequency distribution of the participants' post-performance scores (Figure 14) demonstrated linearity and additivity. However, a number of plots deviated from the diagonal, and the histograms

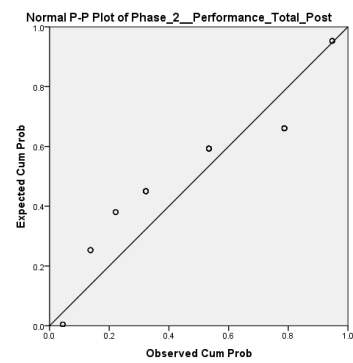
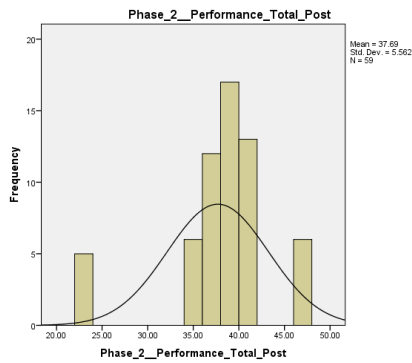
did not appear to have normal distribution. Therefore, z scores for skewness and kurtosis were calculated for the post-performance scores in all three phases (Table 10). This analysis identified a significant negative skew (-3.74) and platykurtic kurtosis (4.03) in the data from P1, and a significant platykurtic kurtosis (-2.82) in P3. This suggested that the data from the post-performance scores for these phases was not normally distributed. However, the number of participants in this stage of the study ranged from 59 to 97 (Table 11) and, in terms of the normality and homogeneity of the data, as they were all above thirty satisfied the central limit theorem (Field, 2013, p. 172). The assumption of normality was, therefore, presumed.

Figure 14: Histograms and probability-probability plots (P-P plot) of the frequency distribution for the individual post-performance scores multiple regression analysis

#### Phase 1 post-performance histogram and P-P plots



#### Phase 2 post-performance histogram and P-P plots



### Phase 3 post-performance histogram and P-P plots

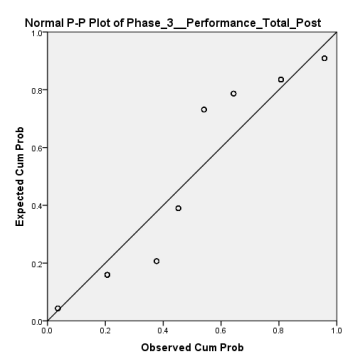
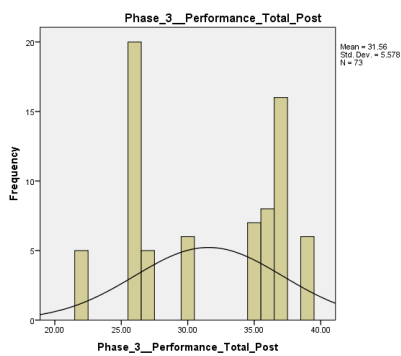


Table 10: Skewness and kurtosis calculations for the individual post-performance scores multiple regression analysis

	Skewness	Standard error of Skewness	Skewness z score	Kurtosis	Standard error of Kurtosis	Kurtosis z score
Phase 1 post-performance scores	.12	.25	0.48	-.53	.49	-1.08
Phase 2 post-performance scores	-1.16	.31	-3.74	2.46	.61	4.03
Phase 3 post-performance scores	-.19	.28	-0.68	-1.58	.56	-2.82

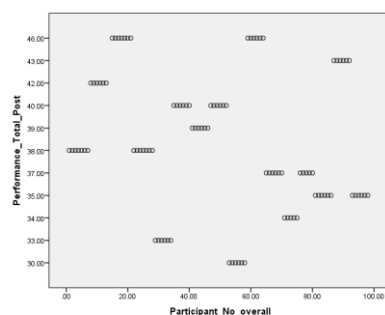
In terms of homogeneity of variance/homoscedasticity, the visual inspection of the scatter plots (Figure 15) did not demonstrate homogeneity. Therefore, the assumption was potentially violated.

Table 11: Participant numbers for the individual post-performance scores multiple regression analysis

Total	Multiple regression
Phase 1 - post-performance	n= 97
Phase 2 – post-performance	n= 59
Phase 3 – post-performance	n= 73

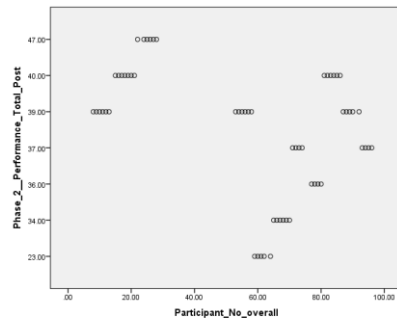
Figure 15: Scatter plot for the individual post-performance scores multiple regression analysis

Phase 1 – post-performance scatter plot

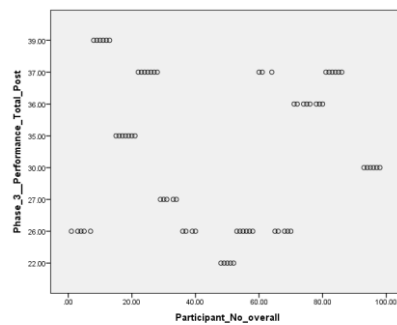




## Phase 2 – post-performance scatter plot



## Phase 3 – post-performance scatter plot



### 5.2.3.5.2.2 - Phase 1 analysis

The dependent variable entered was the P1 post-performance scores of the participants, together with a range of demographic and SBE based independent predictor variables. Again, the number of predictor variables was based on the recommendation by Field (2013, p. 313), which was one predictor variable to ten cases; therefore, in this study, approximately ten predictor variables were used, which were:

- Demographic predictors:
  - Age Group, with the dummy variables of:

- Age 18 – 24 (Baseline)
  - Age 25 plus
- Level of study, with the dummy variables of:
  - Advanced diploma (Baseline)
  - Degree
- Study predictors
  - Condition, with the dummy variables of:
    - Intervention arm
    - Comparison arm (Baseline)
  - Knowledge predictors
    - Total Knowledge Pre intervention
  - Self-efficacy predictors
    - Self-efficacy total Pre intervention
  - Preparation for phase 1
  - Scenario predictors, with the dummy variables of:
    - Hypovolaemia (Baseline)
    - Asthma

The analysis identified that the model had a good fit with an  $F$  statistic of  $F_{(7, 75)} = 7.10$ , which was statistically significant ( $p = <.001$ ). Overall 34% ( $R^2 = .40$ ,  $Adj R^2 = .34$ ) of the change in scores was predicted by the model. The intervention, however, did not have a statistically significant effect on the post-performance scores of the participants ( $p = .891$ ). Nevertheless, a number of other predictors did have a statistically significant effect within the model. In contrast to the baseline hypovolaemia scenario, the asthma scenario had a statistically significant positive effect on the post-performance scores ( $F_{(7, 75)} = 7.10$ ,  $p = <.001$ ,  $r = .56$ ,  $p = <.001$ ,  $R^2 = .40$ ,  $Adj R^2 = .34$ ) and, had a large positive correlation ( $r = .56$ ), which was significant at the .05 level ( $p = <.001$ ). The Beta

coefficients (Table 12) indicated a rise in the scores ( $\beta = .54$ ), which were statistically significant ( $p = <.001$ ). The part correlation (.52) for this predictor was greater than the other predictor variables included in the model.

The level of study also had a statistically significant effect on the post-performance scores. The degree level study, in contrast to the baseline advanced diploma level, had a positive effect ( $F_{(7, 75)} = 7.10$ ,  $p = <.001$ ,  $r = .29$ ,  $p = .004$ ,  $R^2 = .40$ ,  $Adj R^2 = .34$ ) with a small positive correlation ( $r = .29$ ) between the actual gain in scores of the intervention arm and this was significant at the .05 level ( $p = .004$ ). The Beta coefficients (Table 12), also indicated a rise in the scores ( $\beta = .28$ ), which were statistically significant ( $p = .016$ ). The part correlation (.22) for this predictor was the second largest within the model. No other predictor variables had statistically significant Beta coefficients and, there were no statistically significant correlations.

Predictor	Beta	SE B	$\beta$	t - Test	P	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	29.75 (19.18 – 40.33)	5.31		5.61	<.001			
Intervention	-.14 (-2.24 - 1.95)	1.05	-.02	-0.14	.891	-.12	.57	1.75
Degree	2.69 (0.51 – 4.86)	1.09	.28	2.46	.016	.22	.62	1.62
Asthma scenario	4.76 (3.11 - 6.40)	0.83	.54	5.77	<.001	.52	.91	1.10
$R^2 = .40$ , $Adj R^2 = .34$								

All Beta coefficients had a low collinearity since they had variance inflation factors (VIF) above 1 and well below 10, and their tolerance statistic was above 0.2. The Durbin-Watson calculation was  $d = .51$ , which was below the threshold of 1.0 and, therefore, identified that the assumption of independent errors had not been met and autocorrelation was present, leading to potential bias within the results (Field, 2013, p. 311). This would have to be acknowledged throughout my discussion, nevertheless, the model could still be used in relation to the prediction of the independent variables (Field, 2013, p. 311). Nevertheless, it was noteworthy that the findings inferred that the type of scenario, asthma, and level of study, degree level, had a positive effect on the participant's performance. These also appeared to have a positive correlation with the participant's performance, although this was not causal.

#### **5.2.3.5.2.3 - Phase 2 analysis**

In P2, the dependent variable entered was the P2 post-performance scores of the participants, together with a range of demographic and SBE based independent variables to assess their mean effect across the study population. The variables were:

- Demographic predictors:
  - Age Group, with the dummy variables of:
    - Age 18 – 24 (Baseline)
    - Age 25 plus
  - Level of study, with the dummy variables of:
    - Advanced diploma (Baseline)
    - Degree Level
- Study predictors
  - Condition, with the dummy variables of:

- Intervention arm
- Comparison arm (Baseline)
- Knowledge predictor
  - Phase 2 Knowledge Pre-intervention
- Self-efficacy predictor
  - Phase 2 Pre-intervention self-efficacy
- Performance predictor
  - Phase 1 total post scores
- Preparation for phase 2
- Scenario predictors, with the dummy variables of:
  - Sepsis
  - Chest pain (Baseline)

The model had a good fit as it had an  $F$  statistic of  $F_{(8, 47)} = 22.34$ , which was statistically significant ( $p = <.001$ ), and overall 76% ( $R^2 = .79$ ,  $Adj R^2 = .76$ ) of the change in scores were predicted by the model. In contrast to the baseline comparison groups, Sim-TDP had a statistically significant effect on the P2 post-performance scores ( $F_{(8, 47)} = 22.34$ ,  $p = <.001$ ,  $r = .53$ ,  $p = <.001$ ,  $R^2 = .79$ ,  $Adj R^2 = .76$ ) and, had a large positive correlation ( $r = .53$ ), which was significant at the .05 level ( $p = <.001$ ). In contrast to the baseline comparison groups, there was an increase in the Beta coefficients (Table 13), ( $\beta = .91$ , unstandardized Beta coefficients = 11.23), which were statistically significant ( $p = <.001$ ). The part correlation (.71) for this predictor was greater than the other predictor variables included in the model.

The actual scenario also had an effect on the P2 post-performance scores. In contrast to the baseline chest pain scenario, the sepsis scenario had a positive effect ( $F_{(8, 47)} = 22.34$ ,  $p = .003$ ,  $r = .04$ ,  $p = .375$ ,  $R^2 = .79$ ,  $Adj R^2 = .76$ ). The Beta coefficients (Table

13), indicated a rise in the scores ( $\beta = .25$ , unstandardized Beta = 3.00), which were statistically significant ( $p = .003$ ). The part correlation (.21) for this predictor was the second largest of the predictor variables. However, the correlation of this predictor was not statistically significant. The participants' self-efficacy scores pre-intervention also had a statistically significant positive effect on the post-performance scores ( $F_{(8, 47)} = 22.34$ ,  $p = .003$ ,  $r = .05$ ,  $p = .372$ ,  $R^2 = .79$ ,  $Adj R^2 = .76$ ), with the Beta coefficients (Table 13) indicating a rise in the scores ( $\beta = .16$ ), which were statistically significant ( $p = .035$ , unstandardized Beta = 0.41). The part correlation (.15) for this predictor was the third largest within the model, but the correlation with the other predictor variables was not statistically significant. The participants' knowledge pre-intervention also had a statistically significant, but negative, effect on the post-performance scores ( $F_{(8, 47)} = 22.34$ ,  $p < .001$ ,  $r = -.40$ ,  $p < .001$ ,  $R^2 = .79$ ,  $Adj R^2 = .76$ ). It also demonstrated a medium negative correlation ( $r = -.40$ ) with the post-performance scores, which was significant at the .05 level ( $p = .001$ ). The Beta coefficients (Table 13) indicated a fall in scores ( $\beta = -.19$ , unstandardized Beta = -0.69), which again were statistically significant ( $p = .015$ ). The part correlation (-.17) for this predictor was the third lowest within the model.

No other predictor variables had statistically significant Beta coefficients. However, the secondary analysis demonstrated that a number of predictors had statistically significant correlations. These included the participants level of study with degree level study having a large positive correlation ( $r = .53$ ,  $p < .001$ ), whilst the advanced diploma had a large negative correlation ( $r = -.53$ ,  $p < .001$ ). The participants' post-performance scores in P1, also had a large negative correlation ( $r = -.30$ ,  $p = .013$ ) and, the preparation that the participants' undertook prior to P2 had a small positive effect ( $r = .26$ ,  $p = .028$ ).

Table 13: Phase 2 Beta coefficients, multiple regression – individual post-performance scores								
Predictor	Beta	SE B	$\beta$	t - Test	P	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	71.60 (56.17 – 87.02)	7.68		9.34	<.001			
Intervention	11.23 (-1.59 - 2.89)	1.05	.04	.91	<.001	.71	.61	1.64
Total knowledge pre	-6.9 (-1.24 – -.14)	.27	-.19	-2.53	.015	-.17	.79	1.27
Self-efficacy total pre	4.14 (0.31 – 0.80)	0.19	.16	2.17	.035	.15	.86	1.17
Sepsis scenario	3.00 (1.09 - 4.91)	0.95	.25	3.16	.003	.21	.72	1.39
$R^2 = .79$ , Adj $R^2 = .76$								

All Beta coefficients had a low collinearity as they had variance inflation factors (VIF) above 1 and well below 10, and their tolerance statistic was above 0.2. The Durbin-Watson calculation was  $d = .84$ , which was below the threshold of 1.0 and, therefore, identified that the assumption of independent errors had not been met and, again this would be acknowledged during the discussion. Nevertheless, it was worth noting that the findings inferred that both Sim-TDP, the participants' self-efficacy pre-intervention and the type of scenario, sepsis, had a positive effect on the participant's performance. However, their pre-intervention knowledge scores had a negative, effect on the post-performance scores. These also appeared to be positive correlations between the level of study, degree level, and the preparation the participants' undertook, whilst their post-performance scores in P1 had a negative correlation with their performance, although this was not causal.

#### 5.2.3.5.2.4 - Phase 3 analysis

In P3, the dependent variable entered was the individual post-performance scores of the participants, and a range of demographic and SBE based independent variables were entered. The variables were:

- Demographic predictors:
  - Age Group, with the dummy variables of:
    - Age 18 – 24 (Baseline)
    - Age 25 plus
  - Level of study, with the dummy variables of:
    - Advanced Diploma (Baseline)
    - Degree
- Study predictors
  - Condition, with the dummy variables of:
    - Intervention arm
    - Comparison arm (Baseline)
  - Knowledge predictor
    - Phase 3 Pre-intervention knowledge score
  - Self-efficacy predictor
    - Phase 3 Pre-intervention self-efficacy score
  - Performance predictor
    - Phase 2 total performance score post
  - Scenario predictors, with the dummy variables of:
    - Myocardial Infarction (Baseline)
    - Anaphylaxis



- Phase 3 preparation

The model generated had a good fit, as it had an  $F$  statistic of  $F_{(7, 36)} = 9.74$ , which was statistically significant ( $p = <.001$ ) and overall, 59% ( $R^2 = .65$ ,  $Adj R^2 = .59$ ) of the change in scores were predicted by the model. The intervention had a statistically significant effect on the P3 post-performance scores ( $F_{(7, 36)} = 9.74$ ,  $p = <.001$ ,  $r = .53$ ,  $p = <.001$ ,  $R^2 = .65$ ,  $Adj R^2 = .59$ ) and, in contrast to the baseline comparison groups, also had a large positive correlation ( $r = .53$ ), which was significant at the .05 level ( $p = <.001$ ). The Beta coefficients (Table 14) indicated a rise in the scores ( $\beta = .64$ , unstandardised beta 6.36), which were statistically significant ( $p = <.001$ ). The part correlation (.50) for this predictor was greater than the other predictor variables included in the model. The other main effects identified by the analysis were in relation to the scenarios with the anaphylaxis scenario having a statistically significant positive effect ( $F_{(7, 36)} = 9.74$ ,  $p = <.001$ ,  $r = .59$ ,  $p = <.001$ ,  $R^2 = .65$ ,  $Adj R^2 = .59$ ) in comparison to the baseline myocardial infarction scenario. It also had a large positive correlation ( $r = .59$ ) with the scores of the participants, which was significant at the  $p = .05$  level ( $p = <.001$ ). The Beta coefficients (Table 14) indicated a rise in the scores ( $\beta = .51$ , unstandardised beta 4.91). The part correlation (.43) for this predictor was the second largest in the model. The participants' P2 total post-performance score ( $F_{(7, 36)} = 9.74$ ,  $p = <.001$ ,  $r = .21$ ,  $p = .087$ ,  $R^2 = .65$ ,  $Adj R^2 = .59$ ), also had a statistically significant ( $p = .041$ ), but negative effect, with Beta coefficients (Table 14) indicating a fall in the scores ( $\beta = -.29$ , unstandardized Beta = -0.30), which again was statistically significant ( $p = .041$ ). This predictor did not correlate with other predictors in the model.

No other predictor variables had statistically significant Beta coefficients. However, on secondary analysis a number of predictors had significant correlation with the post-performance scores. Degree level study had a large positive correlation ( $r = .53$ ,  $p =$

<.001), whilst the advanced diploma had a large negative correlation ( $r = -.53$ ,  $p = <.001$ ). The participants' total knowledge pre-intervention had a moderate negative correlation ( $r = -.31$ ,  $p = .019$ ) with the post-performance scores. All Beta coefficients had a low collinearity as they had variance inflation factors (VIF) above 1 and well below 10 and the tolerance statistic was above 0.2. The Durbin-Watson calculation was  $d = .62$ , which identified that the assumption of independent errors had not been met, and again, this would have to be acknowledged in the discussion.

Table 14: Phase 3 Beta coefficients, multiple regression – individual post-performance scores								
Predictor	<i>Beta</i>	<i>SE B</i>	$\beta$	<i>t</i> - Test	<i>P</i>	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	52.83 (20.51 – 85.16)	15.94		3.32	.002			
Intervention	6.36 (3.85 - 8.87)	1.24	.64	5.14	<.001	.51	0.62	1.61
Anaphylaxis scenario	4.91 (2.61 - 7.20)	1.13	.51	4.33	<.001	0.43	0.69	1.46
P2 performance total post	-.30 (-0.59 - -0.01)	0.14	-.29	-2.12	.041	-.21	.51	1.97
$R^2 = .65$ , $Adj R^2 = .59$								

Nevertheless, it was once again worth noting that the findings inferred that both Sim-TDP, and the type of scenario, anaphylaxis, had a positive effect on the participant's performance, whilst their total post-performance scores in P2 had a negative effect. There also appeared to be positive correlation between the level of study, degree level, and the preparation the participants' undertook, whilst their total knowledge pre-

intervention had a negative correlation with their performance, although this was not causal.

#### **5.2.3.5.3 - Multiple regression – gain in performance scores of the intervention arm**

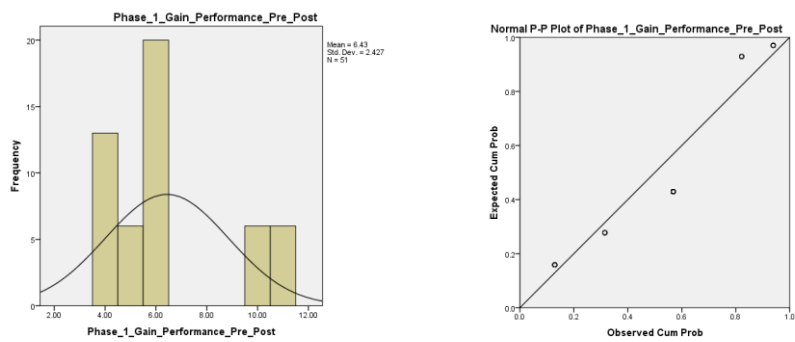
As the mixed ANOVA demonstrated a statistically significant gain in the mean scores of the intervention arm, following the Sim-TDP intervention, I explored what variables potentially had an effect on the scores of the participants in the intervention arm (N= 51). I excluded the comparison arm from this stage since it only had one performance score per phase. As the individual performance, data in the intervention arm had not been assessed for bias and violation of assumptions, I performed a further analysis to assess for additivity and linearity, normality, and homogeneity of variance/homoscedasticity.

##### **5.2.3.5.3.1 – Diagnostic tests**

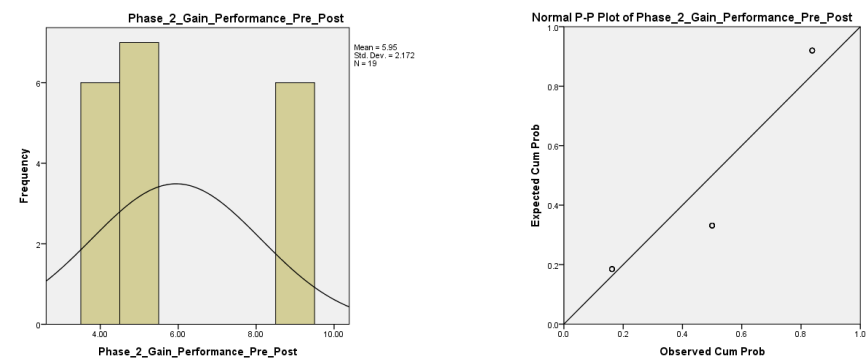
The histograms and probability-probability plots (P-P plot) of the frequency distribution of the participants' performance scores (Figure 16) demonstrated linearity and additivity in the scores, however, a number of plots deviated from the diagonal and, in addition, the histograms did not appear to have normal distribution.

Figure 16: Histograms and probability-probability plots (P-P plot) of the frequency distribution for the gain in performance scores of the intervention arm

Phase 1 change in performance histogram and P-P plots



Phase 2 change in performance histogram and P-P plots



Phase 3 change in performance histogram and P-P plots

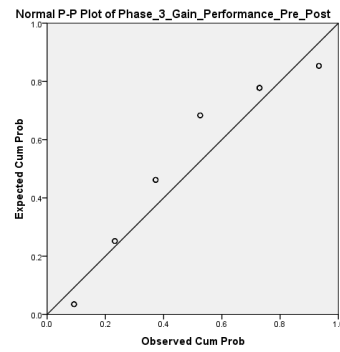
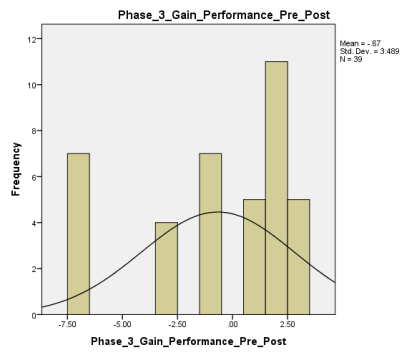


Table 15: Skewness and kurtosis calculations for the gain in performance scores multiple regression analysis

	Skewness	Standard error of Skewness	Skewness z score	Kurtosis	Standard error of Kurtosis	Kurtosis z score
Phase 1 change in performance	.93	.33	2.82	-.55	.66	-0.83
Phase 2 change in performance	.73	.52	1.40	-1.44	1.01	-1.43
Phase 3 change in performance	-.88	.39	-2.26	-.58	.74	-0.78

The z scores were calculated to assess skewness and kurtosis (Table 15). The analysis identified a statistically significant skew in the data, with P1 having a statistically significant positive skew and, P3 having statistically significant negative skew. There were no statistically significant kurtosis in the data. This analysis suggested that the performance scores for these phases were not normally distributed. The number of participants in the study varied from phase to phase and ranged from 19 to 51 (Table 16). In terms of homogeneity, P1 and P3 satisfied the central limit theorem (Field, 2013, p. 172), but the numbers in P2 (n= 19) were insufficient to

assume normal distribution of the dependent variables. Due to this, a Shapiro-Wilk tests was undertaken on the P2 data (Table 17), and this was statistically significant, demonstrating that the P2 data was not normally distributed. The scatter plots (Figure 17) also did not demonstrate homogeneity of variance/homoscedasticity.

Table 16: Multiple regression participant numbers for the gain in performance scores of the intervention arm

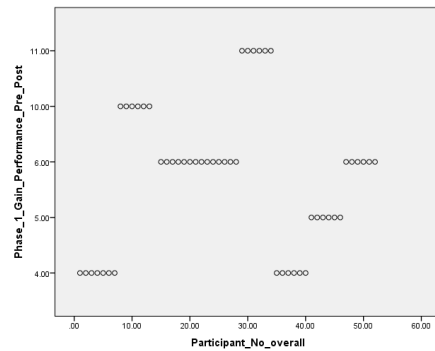
Total	Multiple regression
Phase 1 - performance	n= 51
Phase 2 - performance	n= 19
Phase 3 - performance	n= 39

Table 17: Shapiro-Wilk tests on the gain in performance scores of the intervention arm

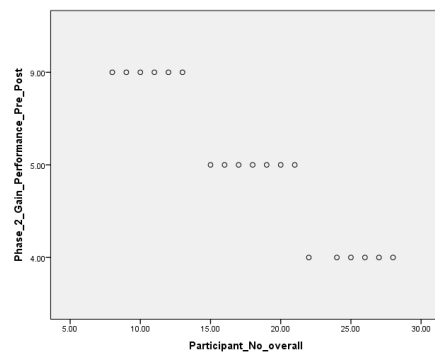
	Shapiro-Wilk		
	Statistic	df	Sig.
Phase 2 change in performance	.71	19	<.001

Figure 17: Scatter plots for the gain in performance scores of the intervention arm

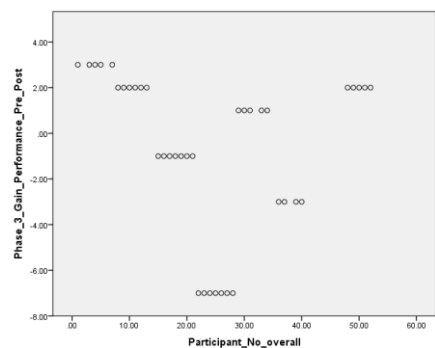
#### Phase 1 – change in performance scatter plot



#### Phase 2 – change in performance scatter plot



#### Phase 3 – change in performance scatter plot



#### 5.2.3.5.3.2 - Phase 1 analysis

The multiple regression analyse was performed to explore which variables had a predictor effect on the gain in the participant's performance scores in the intervention groups. The dependent variable entered was the gain in score of the participants, and a range of demographic and SBE based independent variables were entered. The variables were:

- Demographic predictors:
  - Age Group, with the dummy variables of:
    - Age 18 – 24 (Baseline)
    - Age 25 plus
  - Level of study, with the dummy variables of:
    - Advanced diploma (Baseline)
    - Degree
- Study predictors
  - Knowledge predictors
    - Gain in Knowledge Pre-Post intervention
  - Confidence predictors
    - Gain Confidence Pre-Post intervention
  - Scenario predictors, with the dummy variables of:
    - Hypovolaemia (Baseline)
    - Asthma

Due to the potential violation of assumptions, a bootstrap method was adopted using 1000 samples (Field, 2013, p. 199). The analysis identified that the model did not have a good fit having as it had an  $F$  statistic of  $F_{(5, 36)} = 2.00$ , which was not statistically significant ( $p = .102$ ). Overall, 11% ( $R^2 = .22$ ,  $Adj R^2 = .11$ ) of the change in scores was



predicted by the model. Despite the fact that the model did not have a good fit, a number of predictors had statistically significant effects within the model. In contrast to the baseline hypovolaemia scenario, the actual asthma scenario had a statistically significant negative effect on the gain in scores of the intervention arm participants ( $F_{(5, 36)} = 2.00$ ,  $p = < .102$   $r = -.41$ ,  $p = .003$ ,  $R^2 = .22$ ,  $Adj R^2 = .11$ ). It also had a moderate negative correlation ( $r = -.41$ ) with the actual gain in scores, which was significant at the .05 level ( $p = .003$ ). The Beta coefficients (Table 18) also indicated a fall in the scores in this arm ( $\beta = -.42$ , unstandardized Beta = -2.03), which again were statistically significant ( $p = .020$ ). The part correlation for this predictor variable was greater (-.42) than the other predictors. No other predictor variables had statistically significant Beta coefficients or, statistically significant correlations.

Table 18: Phase 1 Beta coefficients, multiple regression participant numbers for the gain in performance scores of the intervention arm								
Predictor	Beta	SE B	$\beta$	t - Test	P	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	9.26 (6.24 – 12.24)	1.50		7.04	.001			
Asthma scenario	-2.03 (-3.44 - -5.33)	0.03	-.42	-12.01	.020	-.42	.97	1.03
$R^2 = .83$ , $Adj R^2 = .81$								
<i>P values, confidence intervals and standard errors based on 1000 bootstrap samples</i>								

All Beta coefficients had a low collinearity as they had variance inflation factors (VIF) above 1 and well below 10, and their tolerance statistic was above 0.2. The Durbin-Watson test was  $d = .57$ , which was below the threshold of 1.0 and, therefore, identified

that the assumption of independent errors had not been met. Nevertheless, it was worth noting that the findings inferred that the type of scenario had an effect on the participant's performance.

#### **5.2.3.5.3.3 - Phase 2 analysis**

The multiple regression analyse was performed again using the bootstrap method to identify which variables had a predictor effect on the changes in the performance scores of the intervention groups. The dependent variable entered was the gain in score of the participants in P2, and a range of demographic and SBE based independent variables were entered. The variables were:

- Demographic predictors:
  - Age Group, with the dummy variables of:
    - Age 18 – 24 (Baseline)
    - Age 25 plus
  - Level of study, with the dummy variables of:
    - Advanced diploma (Baseline)
    - Degree Level
- Study predictors
  - Knowledge predictor
    - Phase 2 gain in Knowledge Pre-Post intervention
  - Self-efficacy predictor
    - Phase 2 self-efficacy gain Pre-Post intervention
  - Performance predictor
    - Phase 1 total post scores
  - Preparation for phase 2

- Scenario predictors, with the dummy variables of:
  - Sepsis
  - Chest pain (Baseline)

The model generated did not have a good fit as it had an  $F$  statistic of  $F(5, 9) = .72$ , and was not statistically significant ( $p = .635$ ) with less than 1% ( $R^2 = .29$ ,  $Adj R^2 = -.11$ ) of the change in scores being predicted by the model. There were no main effects identified in the beta coefficients. The participants' preparation for P2 led to a fall in the Beta coefficients ( $\beta = -.69$ , unstandardised beta =  $-2.73$ ) and, therefore, on the gain in scores on the intervention arm. This was also evident in the secondary analysis where the preparation for P2 had a statistically significant moderate negative correlation ( $r = -.46$ ,  $p = .043$ ,  $R^2 = .29$ ,  $Adj R^2 = -.11$ ). The participants' age group also had a statistically significant correlation with the gain in scores. Those participants' aged between 18 – 24 years of age had a small negative correlation ( $r = -.25$ ,  $p = .018$ ), whereas the participants' over the age of 25 years of age had a small positive correlation ( $r = .25$ ,  $p = .018$ ). Nevertheless, it was once again worth noting that the findings inferred that the participants' preparation for P2 had a negative effect on the gain in scores of the intervention arm, whilst age, over 25 years, had a positive effect on their gain in performance.

#### **5.2.3.5.3.4 - Phase 3 analysis**

In P3, the multiple regression analyse was performed again using the bootstrap method. The dependent variable entered was the gain in score of the participants and, a range of demographic and SBE based independent variables were entered. The variables were:

- Demographic predictors:
  - Age Group, with the dummy variables of:
    - Age 18 – 24 (Baseline)
    - Age 25 plus
  - Level of study, with the dummy variables of:
    - Advanced Diploma (Baseline)
    - Degree
- Study predictors
  - Knowledge predictor
    - Phase 3 gain in Knowledge Pre-Post intervention
  - Self-efficacy predictor
    - Phase 3 self-efficacy gain Pre-Post intervention
  - Performance predictor
    - Phase 2 total performance score post
  - Scenario predictors, with the dummy variables of:
    - Myocardial Infarction (Baseline)
    - Anaphylaxis
  - Phase 3 preparation

The model generated had a good fit, as it had an  $F$  statistic of  $F_{(6, 25)} = 3.09$ , which was statistically significant ( $p = .021$ ) and, overall, 29% ( $R^2 = .43$ ,  $Adj R^2 = .29$ ) of the change in scores were predicted by the model. The main effects identified by the analysis were in relation to the scenarios. The anaphylaxis scenario relative to the baseline myocardial infarction scenario had a statistically significant negative effect ( $F_{(6, 25)} = 3.09$ ,  $p = 0.021$ ,  $r = -.35$ ,  $p = .025$ ,  $R^2 = .43$ ,  $Adj R^2 = .29$ ). A moderate negative correlation ( $r = -.35$ ) between the actual scenario and the gain in scores of the participants was also found, which was significant at the  $p = .05$  level ( $p = .025$ ). The

Beta coefficients (Table 19) indicated a fall in scores ( $\beta = -.43$ , unstandardised beta = -2.83). The part correlation for this predictor was greater (-.42) than the other predictor variables included in the model ( $p = .033$ ). No other predictor variables had statistically significant Beta coefficients. However, on secondary analysis, the age of the participants had a significant correlation with the gain in scores of the intervention groups. Those participants aged between 18 – 24 years of age had a small negative correlation ( $r = -.38$ ,  $p = .017$ ), whereas the participants over the age of 25 years of age had a small positive correlation ( $r = .38$ ,  $p = .017$ ) with the gain in scores of the intervention groups.

Table 19: Phase 3 Beta coefficients, multiple regression participant numbers for the gain in performance scores of the intervention arm								
Predictor	Beta	SE B	$\beta$	t - Test	P	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	-1.83 (-4.43 – 1.64)	1.49		-1.04	.309			
Anaphylaxis scenario	-2.83 (-4.91 - -.70)	1.05	-.43	-2.75	.033	-0.42	0.95	1.05
$R^2 = .43$ , Adj $R^2 = .29$								
<i>P values, confidence intervals and standard errors base on 1000 bootstrap samples</i>								

All Beta coefficients had a low collinearity as they had variance inflation factors (VIF) above 1 and below 10, and their tolerance statistic was above 0.2. The Durbin-Watson calculation was  $d = .64$  therefore identified that the assumption of independent errors was not met. Nevertheless, it was worth noting that the results inferred that the type of scenario had an effect on the gain in scores of the intervention arm. There also appeared to be a positive correlation between the participant's age, over 25 years, and the gain, although this was not causal.

#### **5.2.4 - Time on task data**

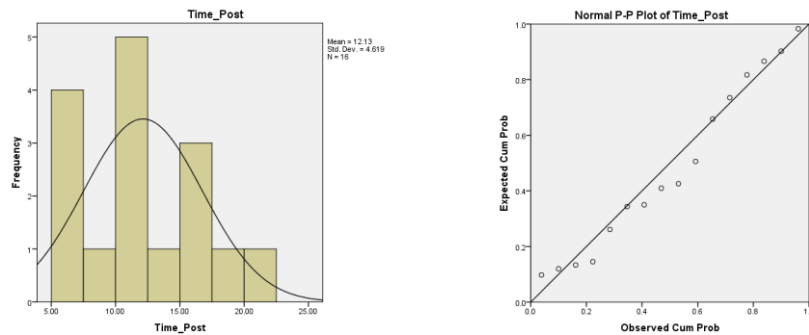
To further assess the effect of the Sim-TDP enhancement on the intervention arm the post-performance time on task was compared to that of the comparison arm receiving the traditional SBE activity.

##### **5.2.4.1 – Diagnostic tests**

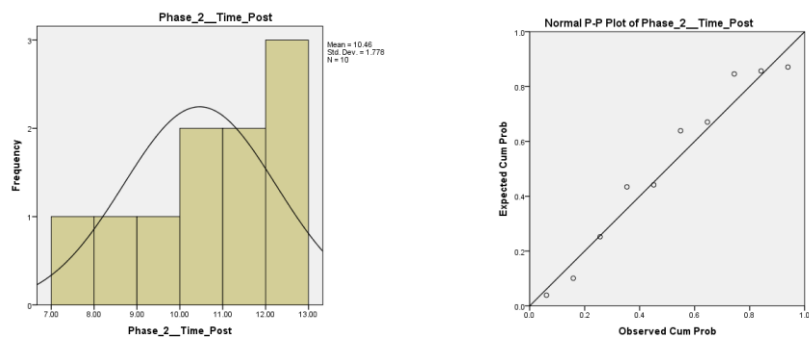
As the post-performance time on task data was based on the consensus marks from the two independent raters and myself, the process for identifying and removing outliers was not undertaken. The data was assessed, however, for bias and violations of assumptions. Histograms and probability-probability plots (P-P plot) for each of the subgroup's time on task were checked for normality (Figure 18). Although the P-P plots demonstrated that the scores were linear and additive in nature, the individual plots appeared to drift from the diagonal line, therefore, indicating potential problems with skew and kurtosis. The histograms also appeared not to have a normal distribution, therefore, further analysis was undertaken to calculate the skewness and kurtosis for the subgroup post-performance time in task data in all three phases (Table 20). z-scores were calculated for skewness and kurtosis for all phases and, did not demonstrate a statistically significant skew or kurtosis. This suggested that the data was normally distributed. As the data was normally distributed the Shapiro-Wilk test was not undertaken.

Figure 18: Histograms and probability-probability plots (P-P plot) of the frequency distribution for the post-performance time on task

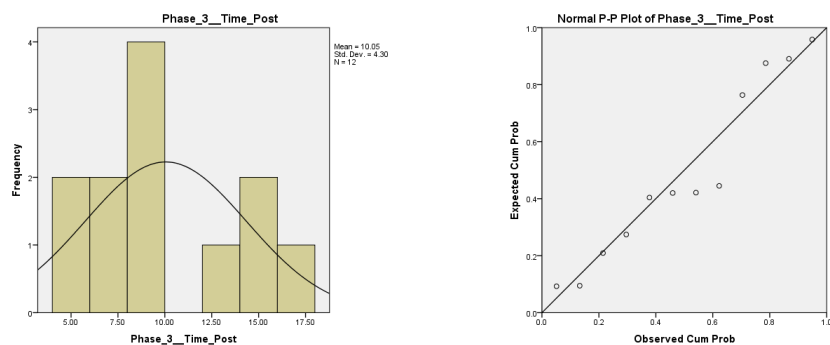
### Phase 1 post-performance time on task histogram and P-P plots



### Phase 2 post-performance time on task histogram and P-P plots



### Phase 3 post-performance time on task histogram and P-P plots



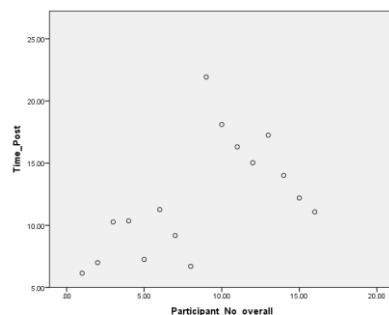
In terms of homogeneity of variance/homoscedasticity, the visual inspection of the scatter plots (Figure 19) identified that they did not appear to have homogeneity. Therefore, the assumption had been potentially violated, which required further analysis.

Table 20: Skewness and kurtosis calculations for the post-performance time on task

	Skewness	Standard error of Skewness	Skewness z score	Kurtosis	Standard error of Kurtosis	Kurtosis z score
Phase 1 performance post time on task	0.56	0.56	1	-0.41	1.09	-0.22
Phase 2 performance post time on task	-0.55	0.69	-0.80	-0.74	1.33	-0.56
Phase 3 performance post time on task	0.39	0.64	0.61	-0.90	1.23	-0.73

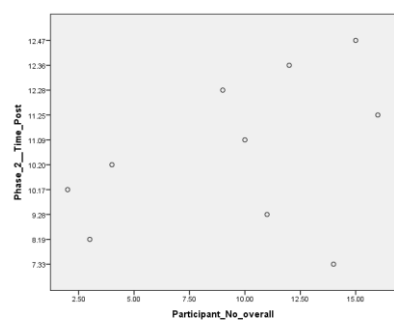
Figure 19: Scatter plots for the post-performance time on task

Phase 1 – post-performance time on task scatter plot





## Phase 2 – post-performance time on task scatter plot



## Phase 3 – post-performance time on task scatter plot

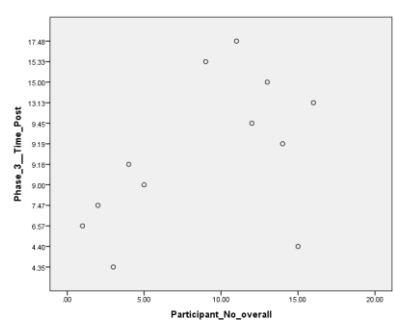


Table 21: Comparison of the baseline means of the time on task

	Condition	Group statistics		
		n	Mean	SE
Phase 1 performance post time on task	Comparison	8	15.74	1.23
	Intervention	8	8.52	0.70
Phase 2 performance post time on task	Comparison	7	10.86	0.72
	Intervention	3	9.52	0.66
Phase 3 performance post time on task	Comparison	7	12.00	1.72
	Intervention	5	7.31	0.88

At the sub-group level (N=16) the performance data from each of the three phases was initially analysed to compare the baseline means in the groups pre-performance scores for both the intervention arm (n= 8) undertaking the Sim-TDP intervention and, those in the comparison arm (n= 8) undertaking the traditional SBE approach (Table 21).

#### **5.2.4.2 – Phase 1 analysis**

In P1, the mean time on task on the post-performance data was lower in the intervention sub-groups (n = 8,  $M = 8.52$ ,  $SE = 0.70$ ) than the traditional SBE comparison sub-groups (n = 8,  $M = 15.74$ ,  $SE = 0.70$ ), indicating that the intervention arm completed the scenario faster than the comparison arm. An independent  $t$ -test was undertaken with the time on task as the dependent variable and, the comparison and intervention arms as the grouping variable. To test the assumption of homogeneity of variance/homoscedasticity, I undertook a Levene's test and, this analysis was not statistically significant, therefore, equal variance was assumed. The analysis from the  $t$ -test found the post-performance time on task between the intervention sub-group ( $M = 8.52$ ,  $SE = 0.70$ ) and the traditional SBE comparison sub-groups ( $M = 15.74$ ,  $SE = 0.70$ ), with a mean difference of 7.22, 95% CI (4.19, 10.24), was statistically significant ( $t_{(14)} = 5.12$ ,  $p = <.001$ ) with a very large effect size ( $d = 2.56$ ). The findings inferred that Sim-TDP reduced the time on task of the teams in the intervention arm, thus, implying that they were quicker at achieving the scenario learning objectives than the teams undertaking the traditional SBE.

#### **5.2.4.3 – Phase 2 analysis**

In P2, the review of the descriptive statistics revealed that the post-performance time on task of the intervention groups (n = 3,  $M = 9.52$ ,  $SE = 0.66$ ) was, once again, shorter

than that of the traditional SBE comparison groups ( $n = 7$ ,  $M = 10.86$ ,  $SE = 0.72$ ). This difference was analysed using an independent  $t$ -test and, in terms of the assumption of homogeneity of variance/homoscedasticity, the Levene's test for this phase was not statistically significant, therefore, equal variance was assumed. However, the time on task of the intervention arm ( $M = 9.52$ ,  $SE = 0.66$ ) although shorter than the comparison arm ( $M = 10.86$ ,  $SE = 0.72$ ), with a mean difference of 1.34, 95% CI (-1.45, 4.14), was not statistically significant ( $t_{(8)} = 1.11$ ,  $p = .299$ ). The Cohen's  $d$  statistical test, nevertheless, identified a large effect size ( $d = 0.85$ ). Although not statistically significant the large effect size inferred that Sim-TDP during this phase did have an effect on the teams in the intervention arm reducing their time on task. Although not as large as P1 it implies that they were quicker at achieving the scenario learning objectives than the teams undertaking the traditional SBE.

#### **5.2.4.4 – Phase 3 analysis**

In P3, the review of the descriptive statistics revealed that the post-performance time on task for the intervention arm was, once again, shorter ( $n = 5$ ,  $M = 7.31$ ,  $SE = 0.89$ ) than the comparison arm ( $n = 7$ ,  $M = 12.00$ ,  $SE = 1.72$ ). An independent  $t$ -test was undertaken and, in terms of homogeneity of variance/homoscedasticity, the Levene's test was not statistically significant, therefore, equal variance was assumed. The time on task of the intervention groups ( $M = 7.31$ ,  $SE = 0.89$ ) was shorter than the comparison groups ( $M = 12.00$ ,  $SE = 1.72$ ), with a mean difference of 4.69, 95% CI (-0.18, 9.56), but this was not statistically significant ( $t_{(10)} = -.29$ ,  $p = .058$ ). As with the other phases, a large effect size ( $d = 1.34$ ) was found. Although again, this was not statistically significant the large effect size inferred that Sim-TDP during this phase did have an effect on the teams in the intervention arm reducing their time on task.

Although not as large as P1 it implies that they were quicker at achieving the scenario learning objectives than the teams undertaking the traditional SBE.

## **5.2.5 - Self-efficacy - Analysis**

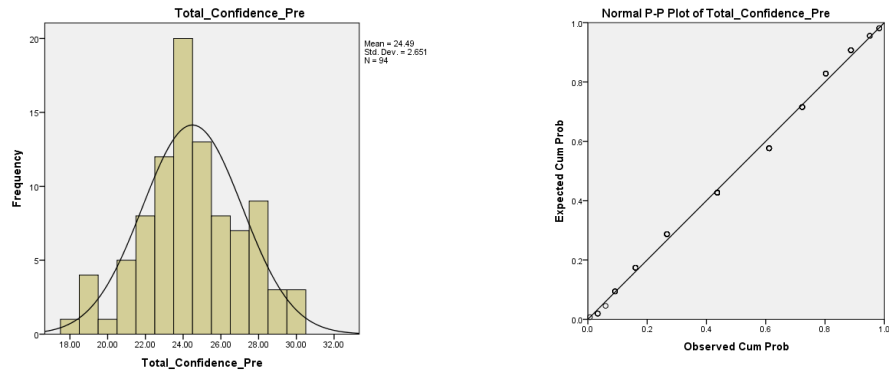
### **5.2.5.1 – Diagnostic tests**

The data from the self-efficacy questionnaires was also assessed for additivity, linearity, normality, and homogeneity of variance/homoscedasticity. As with the other dependent variables in the study, histograms and P-P plots were produced of the frequency distributions (Figure 20). These demonstrated that the scores had an additive and linear relationship. On inspection, the histograms appeared to have a normal distribution, and the z scores for all three phases found no statistically significant skew or kurtosis (Table 22), which suggested that the data was normally distributed. In addition, the number of participants in the study ranged from 42 to 94 (Table 23) so, in terms of homogeneity, these numbers were sufficient to assume normal distribution of the dependent variables under the central limit theorem (Field, 2013, p. 172). As a result, the Shapiro-Wilk and Kolmogorov-Smirnov tests were not undertaken.

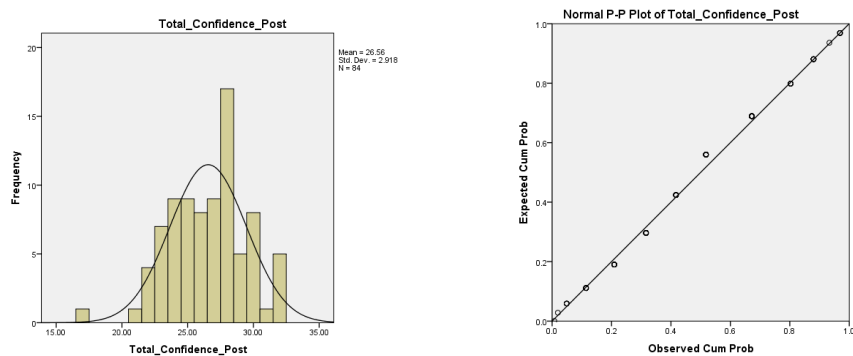
In terms of homogeneity of variance/homoscedasticity, a visual inspection of the scatter plots (Figure 21) revealed that they demonstrated homogeneity in all three phases, therefore, this assumption had been met.

Figure 20: Histograms and probability-probability plots (P-P plot) of the frequency distribution for the self-efficacy scores of the intervention and comparison arms

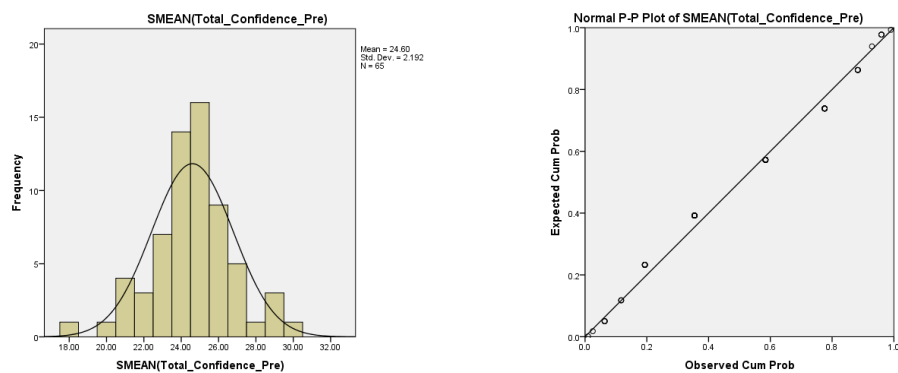
#### Phase 1 – pre self-efficacy histogram and P-P plots



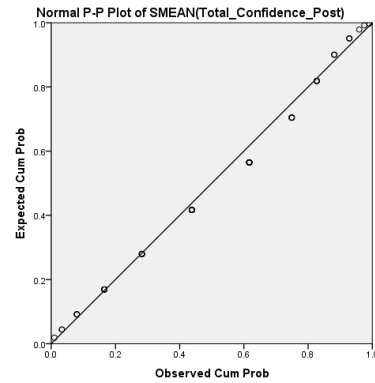
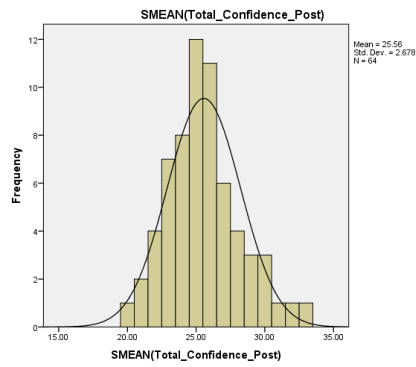
#### Phase 1 – post self-efficacy histogram and P-P plots



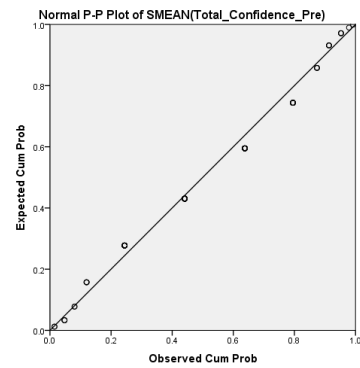
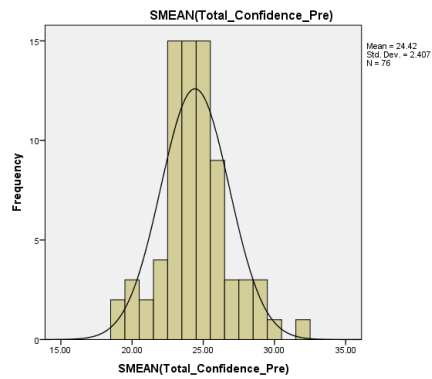
#### Phase 2 – pre self-efficacy histogram and P-P plots



## Phase 2 – post self-efficacy histogram and P-P plots



## Phase 3 – pre self-efficacy histogram and P-P plots



## Phase 3 – post self-efficacy histogram and P-P plots

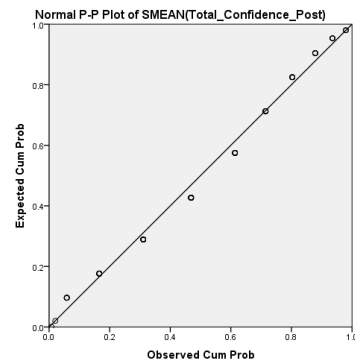
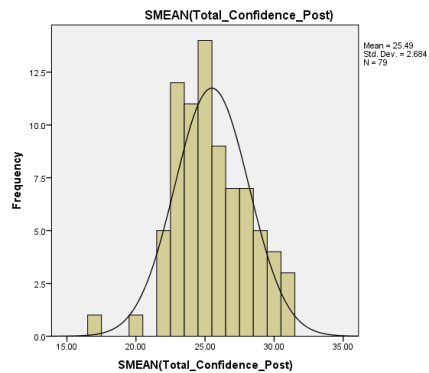


Table 22: Skewness and kurtosis calculations of the self-efficacy scores of the intervention and comparison arms

	Skewness	Standard error of Skewness	Skewness z score	Kurtosis	Standard error of Kurtosis	Kurtosis z score
Phase 1 self-efficacy pre	-.06	.25	-0.24	-.17	.49	-0.35
Phase 1 self-efficacy post	-.29	.26	-1.12	.24	.52	0.46
Phase 2 self-efficacy pre	-.17	.30	0.97	.95	.59	1.61
Phase 2 self-efficacy post	.52	.30	1.73	.32	.59	0.54
Phase 3 self-efficacy pre	.46	.26	1.77	1.01	.55	1.83
Phase 3 confidence post	.001	.27	0.004	.31	.54	0.57

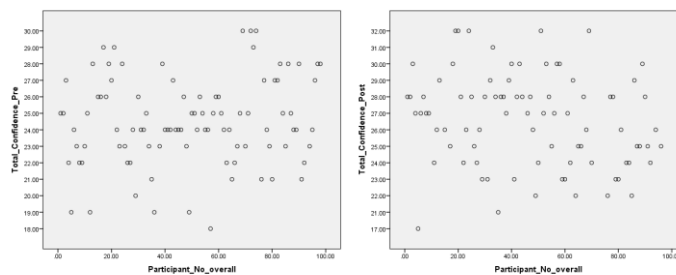
To choose the appropriate test to analyse the data set, I followed the flow chart developed by Cohen et al. (2011, p. 700) and, the *t*-test was identified as suitable test. In addition, the Mann-Whitney *U*-test was recognised as an alternative non-parametric test to the *t*-test if required. This was followed by a mixed ANOVA to compare the groups over time. Multiple regression was also identified to explore the effects of the predictor variables on the dependent variables.

Table 23: Participant numbers in the self-efficacy analyses

Total	Mixed ANOVA	Multiple regression		<i>t</i> - test and Mann-Whitney <i>U</i>
All phases	n= 42 (Intervention n= 16 Comparison n= 26)			
Phase 1 - self-efficacy		n= 68	Pre	n= 94 (Intervention n= 50 Comparison n= 44)
			Post	n= 84 (Intervention n= 48 Comparison n= 36)
Phase 2 - self-efficacy		n= 48	Pre	n= 65 (Intervention n= 25 Comparison n= 40)
			Post	n= 64 (Intervention n= 24 Comparison n= 40)
Phase 3 - self-efficacy		n= 50	Pre	n= 84 (Intervention n= 45 Comparison n= 39)
			Post	n= 79 (Intervention n= 40 Comparison n= 39)

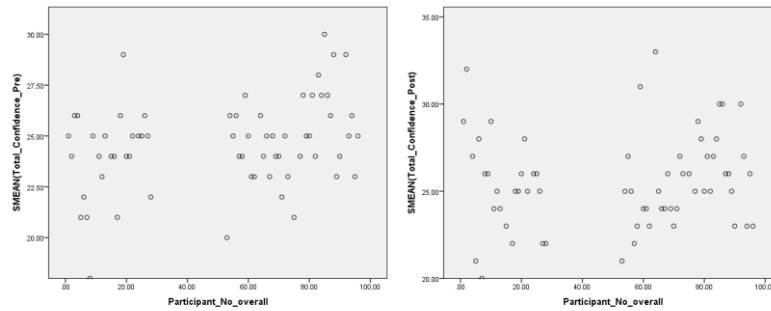
Figure 21: Scatter plots for the self-efficacy scores of the intervention and comparison arms

Phase 1 – pre and post self-efficacy scatter plots

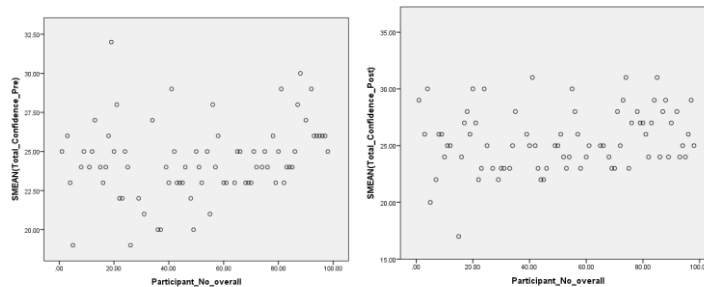




## Phase 2 – pre and post self-efficacy scatter plots



## Phase 3 – pre and post self-efficacy scatter plots



### 5.2.5.2 – *t*-test on participant self-efficacy – all phases

At the individual level, the self-efficacy data from each of the three phases was initially analysed to compare the baseline means in the groups' pre and post self-efficacy scores (Table 24). An independent *t*-test and Mann-Whitney *U* test were initially performed and, demonstrated that in P1 and P2 there was no statistically significant differences in the scores. Although not statistically significant ( $t_{(92)} = 1.37, p = .174$ ) the comparison arms self-efficacy scores in P1 prior to the intervention were higher ( $n = 44, M = 24.89, SE = .41$ ) than the intervention groups ( $n = 50, M = 24.14, SE = .36$ ), with a mean difference of 0.75, 95% CI (-0.34, 1.83) and, a small effect size ( $d = 0.29$ ).

Although the scores increased following the intervention, the comparison arms score reversed and was lower ( $n = 36, M = 25.97, SE = .45$ ) than the intervention ( $n = 48, M =$

27.00,  $SE = .44$ ), with a mean difference of -1.03, 95% CI (-2.30, .24), this was not statistically significant ( $t_{(82)} = -1.61$ ,  $p = .111$ ) and, the effect was small ( $d = 0.36$ ).

This difference in self-efficacy scores, once again, reversed in P2, with the comparison arm having higher scores ( $n = 40$ ,  $M = 24.98$ ,  $SE = .33$ ) prior to the intervention than the intervention arm itself ( $n = 25$ ,  $M = 24.00$ ,  $SE = .45$ ), with a mean difference of 0.98, 95% CI (-0.12, 2.07). This was not statistically significant ( $t_{(63)} = 1.77$ ,  $p = .081$ ) and, had a small effect size ( $d = 0.45$ ). Following the intervention, there was again an increase in the scores for both groups, but the comparison groups scores remained higher ( $n = 40$ ,  $M = 25.75$ ,  $SE = .41$ ) than the intervention arm ( $n = 24$ ,  $M = 25.25$ ,  $SE = .57$ ), with a mean difference of 0.50, 95% CI (-0.89, 1.89). This again was not statistically significant ( $t_{(62)} = 0.72$ ,  $p = .474$ ) and, the effect size was a very small ( $d = 0.18$ ).

Unlike the other two phases, the  $t$ -test in P3 was statistically significant, both for the data prior to and, following the intervention. Prior to the intervention, the comparison group had higher scores ( $n = 39$ ,  $M = 24.95$ ,  $SE = .31$ ) than the intervention group ( $n = 45$ ,  $M = 23.82$ ,  $SE = .37$ ), with a mean difference of 1.13, 95% CI (0.15, 2.10). The  $t$ -test analysis found a statistically significant difference in the pre-intervention scores ( $t_{(82)} = -2.29$ ,  $p = .025$ ) with a moderate effect size ( $d = 0.51$ ). This difference in self-efficacy scores remained the same following the actual intervention. The comparison arm had higher scores ( $n = 39$ ,  $M = 26.10$ ,  $SE = .38$ ) than the intervention arm ( $n = 40$ ,  $M = 24.90$ ,  $SE = .46$ ) with a mean difference of 1.20, 95% CI (0.02, 2.38), which was statistically significant ( $t_{(77)} = -2.03$ ,  $p = .046$ ) with a small effect size ( $d = 0.46$ ).

Table 24: *t*-test data on participant self-efficacy scores of the intervention and comparison arms

	Condition	Number	Mean	Standard error	Cohen's <i>d</i>
P1 total self-efficacy pre	Comparison	44	24.90	.41	
	Intervention	50	24.14	.36	0.29
P1 total self-efficacy post	Comparison	36	25.97	.45	
	Intervention	48	27.00	.44	0.36 (Small)
P2 total self-efficacy pre	Comparison	40	24.98	.33	
	Intervention	25	24	.45	0.45 (Small)
P2 total self-efficacy post	Comparison	40	25.75	.41	
	Intervention	24	25.25	.57	0.18
P3 total self-efficacy pre	Comparison	39	24.95	.31	
	Intervention	45	23.82	.37	0.51 (Moderate)
P3 total self-efficacy post	Comparison	39	26.10	.38	
	Intervention	40	24.90	.46	0.46 (Small)

A Mann-Whitney *U* test was performed with the ranked pre and post self-efficacy scores from P3 and, this revealed a significant difference in the mean rank scores ( $U = 613.00$ ,  $z = -2.41$ ,  $p = .016$ ) between the comparison arm ( $n = 39$ , *mean rank* 49.28) and the intervention arm ( $n = 45$ , *mean rank* 36.62) pre self-efficacy score. However, unlike the *t*-test, the Mann-Whitney *U* test was not statistically significant ( $U = 585.00$ ,

$z = -1.93, p = .054$ ) between the comparison arm ( $n = 39$ , *mean rank* 45.00), and the intervention arm ( $n=40$ , *mean rank* 35.13) post self-efficacy score. Overall, the findings inferred that with the exception of P3 Sim-TDP did not have an effect on the participant's self-efficacy. In P3, the traditional SBE appeared to enhance the participant's self-efficacy.

#### **5.2.5.3 – Mixed ANOVA on participant self-efficacy**

A mixed ANOVA was performed using the pre and post self-efficacy scores as the within-group variables and, the condition (intervention and comparison) as the between-subject variable (Table 25). This was undertaken to analyse the effect over time on the self-efficacy of participant's ( $N = 42$ ) and, indicated that there was no statistical differences in the self-efficacy scores between the groups ( $F_{(1, 40)} = 0.30, p = .585, r^2 = .08$ , observed power .08) (Figure 22). Levene's test was not significant for both the pre and post self-efficacy scores in all three phases. However, Mauchly's test for sphericity was statistically significant  $\chi^2_{(14)} = 36.50, P = <.001$ . This was corrected by using the Greenhouse-Geisser method with an  $\epsilon$  (Epsilon) of .73, as recommended by Field (2013, p. 548). The results showed that there was no statistical difference in the self-efficacy scores between the groups ( $F_{(3.67, 146.72)} = 1.74, P = .151$ ), with a small effect size ( $r^2 = .11$ ), and the observed power was .50. The findings inferred that Sim-TDP did not have an effect on the participant's self-efficacy overtime.

Table 25: Self-efficacy mixed ANOVA data

	Condition	Number	Mean	Standard deviation
P1 total self-efficacy pre	Comparison	26	24.46	2.63
	Intervention	16	24.63	3.24
P1 total self-efficacy post	Comparison	26	25.92	2.50
	Intervention	16	27.06	3.75
P2 total self-efficacy pre	Comparison	26	25.78	1.80
	Intervention	16	24.06	2.50
P2 total self-efficacy post	Comparison	26	25.65	2.42
	Intervention	16	25.25	2.05
P3 total self-efficacy pre	Comparison	26	25.19	2.25
	Intervention	16	24.69	2.73
P3 total self-efficacy post	Comparison	26	26.23	2.23
	Intervention	16	25.81	3.64

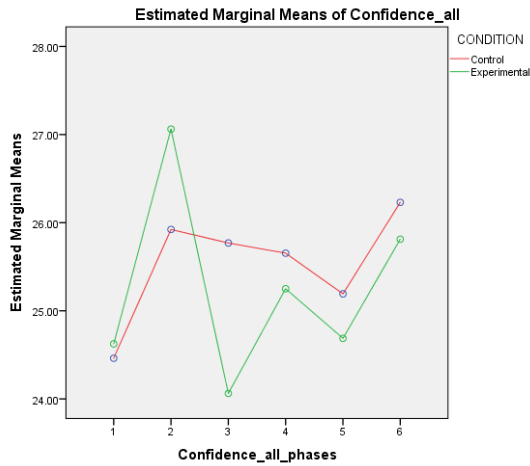


Figure 22: Self-efficacy mixed ANOVA scores

#### 5.2.5.4 – Multiple Regression on participant self-efficacy

##### 5.2.5.4.1 – Phase 1 analysis

The participant's self-efficacy was explored further using a multiple regression analyse. In P1, the dependent variable entered was the gain in self-efficacy of the participants and, a range of demographic and SBE based independent variables were entered. The variables were:

- Demographic predictors:
  - Age Group, with the dummy variables of:
    - Age 18 – 24 (Baseline)
    - Age 25 plus
  - Academic level, with the dummy variables of:
    - Advanced diploma (Baseline)
    - Degree
- Study predictors
  - Condition, with the dummy variables of:

- Intervention arm
- Comparison arm (Baseline)
- Performance predictors
  - Total post-performance
- Knowledge predictors
  - Gain in Knowledge Pre-Post intervention
- Scenario predictors, with the dummy variables of:
  - Hypovolaemia (Baseline)
  - Asthma

The model generated did not have a significant  $F$  statistic ( $F_{(6, 68)} = 1.62, p = .156$ ), thus it did not have a good fit with no statistical significance in the ratio of the variability in the scores. Overall, only 5% ( $R^2 = .13, Adj R^2 = .05$ ) of the change in scores was predicted by the model.

Table 26: Phase 1 Beta coefficients, multiple regression – participant self-efficacy								
Predictor	Beta	SE B	$\beta$	$t$ - Test	$P$	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	6.33 (-8.99 – 13.56)	3.62		1.75	.085			
Intervention	1.28 (-.42 – 2.97)	.85	.21	1.51	.136	.17	.66	1.52
$R^2 = .13, Adj R^2 = .05$								

Although the model did not have a good fit and, the intervention did not have a statistically significant effect ( $F_{(6, 68)} = 1.62, p = .156, r = .17, p = .068, R^2 = .13, Adj R^2 = .05$ ), the comparison arm's Beta coefficients (Table 26) indicated a rise in the scores ( $\beta$

= .21, unstandardized Beta = 1.28). Secondary analysis identified that a number of variables had a significant correlation with the gain in the self-efficacy scores of the intervention sub-groups. The hypovolaemia scenario had a small positive correlation ( $r = .25$ ,  $p = .014$ ,  $R^2 = .13$ ,  $Adj R^2 = .05$ ), and the asthma scenario had a small negative correlation ( $r = -.25$ ,  $p = .014$ ,  $R^2 = .13$ ,  $Adj R^2 = .05$ ). The assumptions related to this analyse and the multi-collinearity diagnostics undertaken demonstrated no effects. The Durbin-Watson test was  $d = 2.1$  and, as this was between 1 – 3, autocorrelation was not present. The findings for this phase inferred that the traditional SBE increased the self-efficacy of the participants. The type of scenario, hypovolaemia, also appeared to have a positive correlation with the participant's self-efficacy, although this was not causal.

#### **5.2.5.4.2 – Phase 2 analysis**

In P2, the dependent variable entered was the gain in self-efficacy and, once again, a range of demographic and SBE based independent variables were entered. The variables were:

- Demographic predictors:
  - Age Group, with the dummy variables of:
    - Age 18 – 24 (Baseline)
    - Age 25 plus
  - Academic level
    - Advanced diploma (Baseline)
    - Degree
- Study predictors



- Condition, with the dummy variables of:
  - Intervention arm
  - Comparison arm (Baseline)
- Performance predictors
  - Phase 2 total performance
- Knowledge predictors
  - Phase 2 gain in Knowledge Pre-Post intervention
- Self-efficacy predictors
  - Phase 1 gain in self-efficacy
- Phase 2 scenario predictors, with the dummy variables of:
  - Sepsis
  - Chest pain (Baseline)
- Phase 2 preparation

The model generated did not have a good fit, as it had an  $F$  statistic of  $F_{(7, 41)} = .90$ , which was not statistically significant ( $p = .514$ ). Overall, 1% ( $R^2 = .13$ ,  $Adj R^2 = .01$ ) of the change in scores was predicted by the model. The analysis, in terms of the difference between the intervention and comparison arms, indicated a positive effect ( $\beta = .27$ , unstandardized Beta = 1.30) (Table 27). No other statistically significant Beta coefficients were noted, except for the performance total post-intervention in P2, which had a statistically significant negative correlation ( $r = -.26$ ,  $p = .037$ ) between the actual gain in self-efficacy. The assumptions related to this analyse were met and the multi-collinearity diagnostics undertaken showed no effects. The Durbin-Watson test was  $d = 1.76$ , which showed no autocorrelation was present. The findings for this phase inferred that Sim-TDP increased the self-efficacy of the participants. Whilst the total

performance scores post-intervention in P2 had a negative correlation with the participant's self-efficacy, although this was not causal.

Table 27: Phase 2 Beta coefficients, multiple regression – participant self-efficacy								
Predictor	<i>Beta</i>	<i>SE B</i>	$\beta$	<i>t</i> - Test	<i>P</i>	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	6.84 (-.10–13.79)	3.44		1.99	.053			
Intervention	1.29 (3.57 – .98)	1.29	.27	1.15	.256	.17	.72	1.39
$R^2 = .13$ , $Adj R^2 = .01$								

#### 5.2.5.4.3 – Phase 3 analysis

In P3, the dependent variable entered was the gain in self-efficacy of the participants and, a range of demographic and SBE based independent variables were entered. These were included to assess their mean effect across the study population. The variables were:

- Demographic predictors:
  - Age, with the dummy variables of:
    - 18 – 24
    - 25 plus
  - Academic level, with the dummy variables of:
    - Advanced Diploma (Baseline)
    - Degree Level
- Study predictors

- Condition, with the dummy variables of:
  - Intervention arm
  - Comparison arm (Baseline)
- Phase 3 performance predictors
  - Phase 3 post-performance total
- Phase 3 self-efficacy predictors
  - Phase 2 gain in self-efficacy
- Phase 3 knowledge predictors
  - Phase 3 gain in Knowledge Pre-Post intervention
- Phase 3 scenario predictors, with the dummy variables of:
  - Myocardial Infarction (Baseline)
  - Anaphylaxis
- Phase 3 preparation

The model generated did not have a good fit, as it had an  $F$  statistic of  $F_{(7, 38)} = 1.06$ , which was not statistically significant ( $p = .411$ ). Overall, 1% ( $R^2 = .16$ ,  $Adj R^2 = .01$ ) of the change in scores was predicted by the model. The analysis, in terms of the difference between the intervention and comparison arms, showed no significant effect on the Beta coefficients (Table 28). No other beta coefficients were statistically significant, however, the P3 preparation the participants undertook had large beta coefficients ( $\beta = .27$ , unstandardized Beta = 1.60), indicating a positive predictor effect of the dependent variable. Secondary analysis found a moderate statistically significant positive correlation between the participants' preparation plans in P3 and their gain in self-efficacy ( $r = .33$ ,  $P = .013$ ,  $R^2 = .16$ ,  $Adj R^2 = .01$ ). Further secondary analysis, identified that the participant's self-efficacy gain in P2 had a small positive correlation ( $r$

= .28,  $p = .021$ ,  $R^2 = .19$ ,  $Adj R^2 = -.02$ ). No other statistically significant Beta coefficients or correlations were noted in this analysis.

Table 28: Phase 3 Beta coefficients, multiple regression – participant self-efficacy								
Predictor	Beta	SE B	$\beta$	t - Test	P	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	0.06 (-8.21 – 8.33)	4.08		0.15	.988			
Phase 3 prep	1.60 (-.32 – 3.51)	.95	.27	1.69	.099	.25	.88	1.14
$R^2 = .16$ , $Adj R^2 = .01$								

The assumptions related to this analyse were met and no multi-collinearity was identified. The Durbin-Watson test was  $d = 2.35$  and this demonstrated no autocorrelation. The findings for this phase inferred that the preparation the participants undertook prior to this phase had a positive effect on the participant's self-efficacy. This also had a positive correlation with the participant's self-efficacy, although this was not causal.

## 5.2.6 - Knowledge Analysis

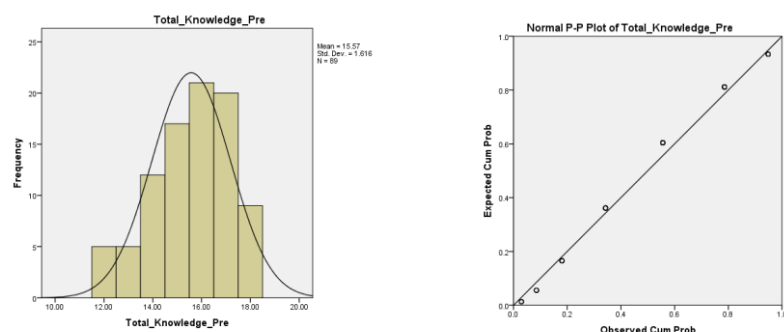
### 5.2.6.1 – Diagnostic tests

The data from the knowledge questionnaires was also assessed for additivity, linearity normality, and homogeneity of variance/homoscedasticity. Histograms and P-P plots

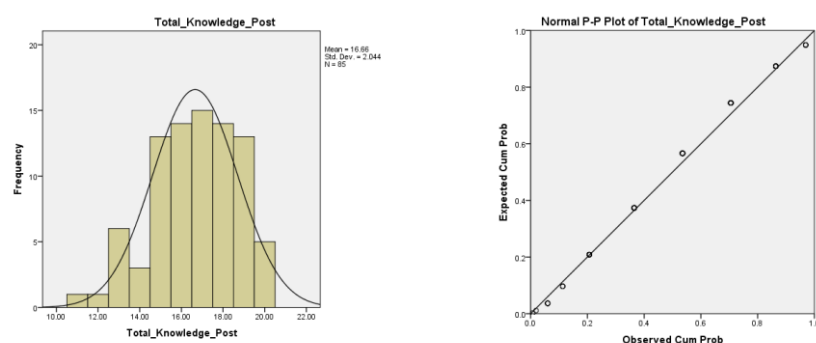
(Figure 23) demonstrated that the scores had an additive and linear relationship and, appeared to have a normal distribution. This was explored further by calculating the z scores for all three phases and, no statistically significant skew or kurtosis was found (Table 29), which suggested that the data was normally distributed. In addition, the number of participants in the study ranged from 38 and 89 (Table 30), which was sufficient to assume normal distribution under the central limit theorem. As advised by Field (2013, p. 184) the Shapiro-Wilk and Kolmogorov-Smirnov tests were not undertaken.

Figure 23: Histograms and probability-probability plots (P-P plot) of the frequency distribution for the knowledge scores of the intervention and comparison arms

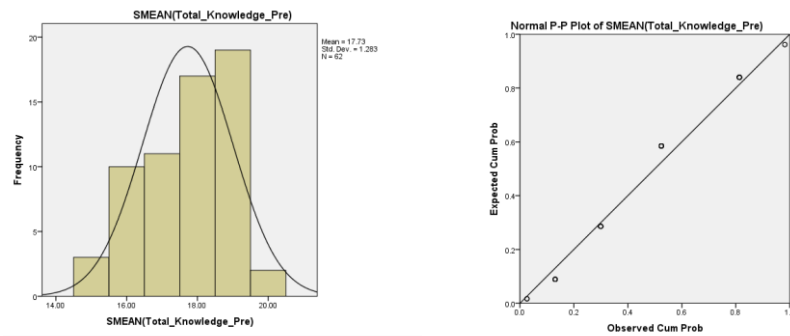
#### Phase 1 – pre knowledge histogram and P-P plots



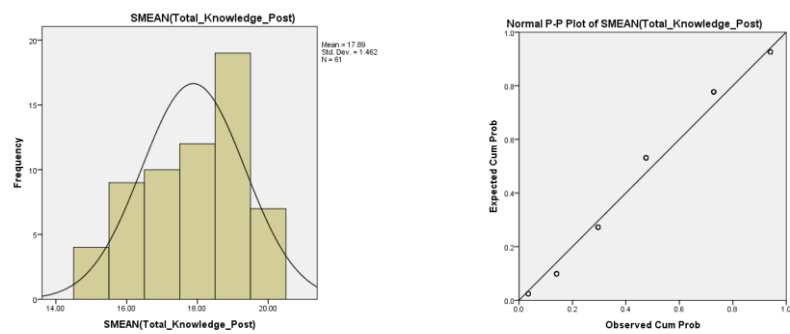
#### Phase 1 – post knowledge histogram and P-P plots



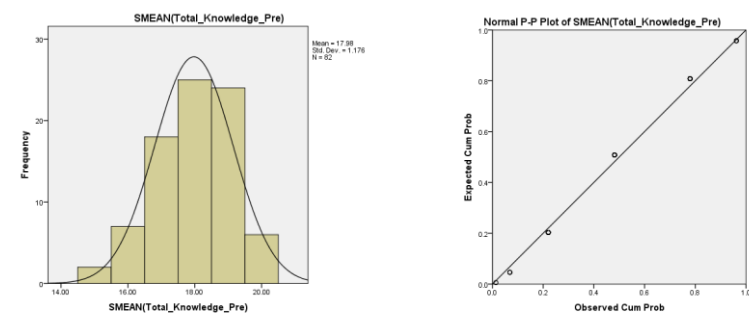
## Phase 2 – pre knowledge histogram and P-P plots



## Phase 2 – post knowledge histogram and P-P plots



## Phase 3 – pre knowledge histogram and P-P plots



### Phase 3 – post knowledge histogram and P-P plots

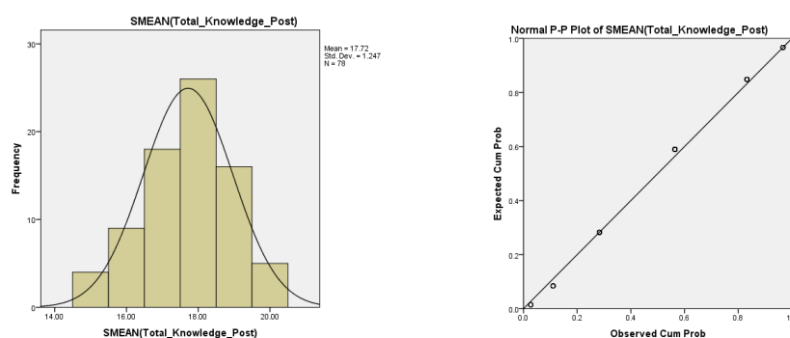


Table 29: Skewness and kurtosis calculations of the knowledge scores of the intervention and comparison arms

	Skewness	Standard error of Skewness	Skewness z score	Kurtosis	Standard error of Kurtosis	Kurtosis z score
Phase 1 knowledge pre	-.48	.26	-1.85	-.42	.51	-0.82
Phase 1 knowledge post	-.44	.26	-1.69	-.27	.52	-0.52
Phase 2 knowledge pre	-.43	.26	-1.65	-.22	.60	-1.23
Phase 2 knowledge post	-.39	.31	-1.26	-.87	.60	-1.45
Phase 3 knowledge pre	-.37	.27	-1.37	-.28	.53	-0.53
Phase 3 knowledge post	-.28	.27	-1.04	-.33	.54	-0.61

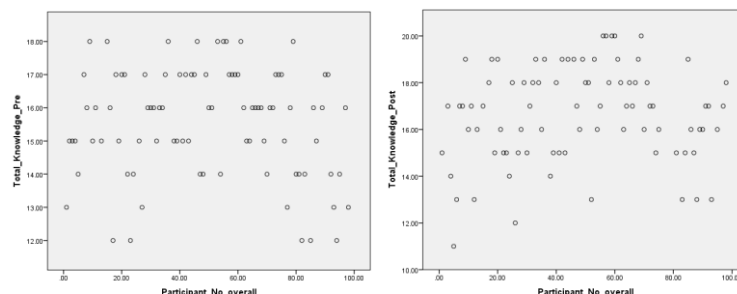
In terms of homogeneity of variance/homoscedasticity, a visual inspection of the scatter plots (Figure 24) undertaken demonstrated homogeneity in all three phases; therefore, this assumption was met.

Table 30: Participant numbers in the knowledge analyses

Total	Mixed ANOVA	Multiple regression		<i>t</i> - test and Mann-Whitney <i>U</i>
All phases	n= 38 (Experimental n= 14 Control n= 24)			
Phase 1 - knowledge		n= 68	Pre	n= 89 (Experimental n= 46 Control n= 43)
			Post	n= 85 (Experimental n= 47 Control n= 38)
Phase 2 – knowledge		n= 46	Pre	n= 62 (Experimental n= 23 Control n= 39)
			Post	n= 61 (Experimental n= 23 Control n= 38)
Phase 3 - knowledge		n= 45	Pre	n= 82 (Experimental n= 45 Control n= 37)
			Post	n= 78 (Experimental n= 40 Control n= 38)

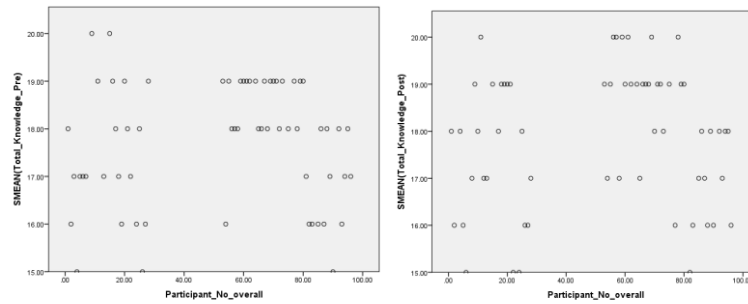
Figure 24: Scatter plots for the knowledge scores of the intervention and comparison arms

#### Phase 1 – pre and post knowledge scatter plots

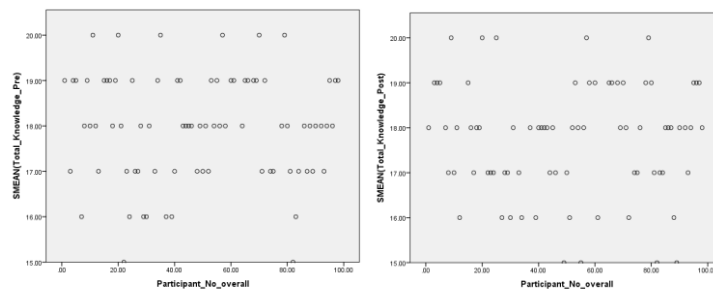




## Phase 2 – pre and post knowledge scatter plots



## Phase 3 – pre and post knowledge scatter plots



### 5.2.6.2 – *t*-test on participant knowledge

At the individual level, the knowledge data from each of the three phases was initially analysed to compare the baseline means in the group's pre and post-knowledge scores (Table 31). A *t*-test and Mann-Whitney *U* test found that there was no statistically significant difference in the scores. The comparison arms knowledge scores in P1 prior to the intervention were lower ( $n = 43$ ,  $M = 15.51$ ,  $SE = .26$ ) than the intervention groups ( $n = 46$ ,  $M = 15.63$ ,  $SE = .22$ ) with a mean difference of  $-0.12$ , 95% CI  $(-0.80, 0.57)$ . The *t*-test analysis found no statistically significant difference in the pre-intervention scores ( $t_{(87)} = -0.35$ ,  $p = .731$ ) and, this had a very small effect size ( $d = -0.07$ ). The Mann-Whitney *U* test was performed with the ranked pre-knowledge scores and this also revealed no statistically significant differences in the mean rank scores (*U*

= 967.00,  $z = -.18$ ,  $p = .854$ ) between the comparison arm ( $n = 43$ , *mean rank* 44.49) and the intervention arm ( $n = 46$ , *mean rank* 45.48). Following the intervention, the comparison arms scores were higher ( $n = 38$ ,  $M = 17.02$ ,  $SE = .31$ ) than the intervention ( $n = 47$ ,  $M = 16.36$ ,  $SE = .31$ ) with a mean difference of 0.66, 95% CI (-0.21, 1.55). The  $t$ -test analysis, once again, found no statistically significant difference in the pre-intervention scores ( $t_{(83)} = 1.50$ ,  $p = .137$ ), this effect was small ( $d = 0.33$ ). The Mann-Whitney  $U$  test on the ranked post-knowledge scores revealed no statistically significant differences in the mean rank scores ( $U = 744.50$ ,  $z = -1.33$ ,  $p = .184$ ) between the comparison arm ( $n = 38$ , *mean rank* 46.91) and the intervention arm ( $n = 47$ , *mean rank* 39.84).

This pattern in the knowledge scores continued in P2, with the comparison arm having higher scores ( $n = 39$ ,  $M = 17.89$ ,  $SE = .19$ ) prior to the intervention than the intervention arm itself ( $n = 23$ ,  $M = 17.43$ ,  $SE = .30$ ) with a mean difference of 0.46, 95% CI (-0.21, 1.13). The  $t$ -test analysis found no statistically significant difference in the pre-intervention scores ( $t_{(60)} = 1.38$ ,  $p = .171$ ), with only a small effect size ( $d = 0.36$ ) found. The Mann-Whitney  $U$  test was performed with the ranked pre-knowledge scores from P2 and this also revealed no statistically significant differences in the mean rank scores ( $U = 354.00$ ,  $z = -1.42$ ,  $p = .156$ ) between the comparison arm ( $n = 39$ , *mean rank* 33.92) and the intervention arm ( $n = 23$ , *mean rank* 27.39). Following the intervention, there was an increase in the comparison arms scores but the intervention group's scores remained the same. The comparison groups scores were higher ( $n = 38$ ,  $M = 18.16$ ,  $SE = .22$ ) than the intervention arms' ( $n = 23$ ,  $M = 17.43$ ,  $SE = .31$ ) with a mean difference of 0.72, 95% CI (-0.03, 1.48). The  $t$ -test analysis found no statistically significant difference in the pre-intervention scores ( $t_{(59)} = 1.91$ ,  $p = .061$ ) and, the Cohen's  $d$  test identified that there was a moderate effect size ( $d = 0.50$ ). The Mann-Whitney  $U$  test on the ranked post-knowledge scores also revealed no statistically

significant differences in the mean rank scores ( $U = 744.50$ ,  $z = -1.33$ ,  $p = .184$ ) between the comparison arm ( $n = 38$ , *mean rank* 34.16) and the intervention arm ( $n = 23$ , *mean rank* 25.78).

Table 31: *t*-test data on participant knowledge scores of the intervention and comparison arms

	Condition	Number	Mean	Standard error	Cohen's <i>d</i>
P1 total knowledge pre	Comparison	43	15.51	.26	
	Intervention	46	15.63	.22	-0.07
P1 total knowledge post	Comparison	38	17.02	.31	
	Intervention	47	16.36	.30	0.33 (Small)
P2 total knowledge pre	Comparison	39	17.90	.19	
	Intervention	23	17.43	.30	0.36 (Small)
P2 total knowledge post	Comparison	38	18.16	.22	
	Intervention	23	17.43	.31	0.50 (Medium)
P3 total knowledge pre	Comparison	37	18.14	.18	
	Intervention	45	17.84	.18	0.26 (Very small)
P3 total knowledge post	Comparison	38	17.87	.21	
	Intervention	40	17.57	.19	0.24 (Very small)

In P3, the comparison arms' scores were higher ( $n= 37$ ,  $M = 18.14$ ,  $SE = .18$ ) than the intervention arm groups ( $n= 45$ ,  $M = 17.84$ ,  $SE = .18$ ) with a mean difference of 0.29, 95% CI (-0.23, 0.81). The  $t$ -test analysis found no statistically significant difference in the pre-intervention scores ( $t_{(80)} = 1.12$ ,  $p = .268$ ) and, a very small Cohen's  $d$  ( $d = 0.26$ ) was found. The Mann-Whitney  $U$  test was performed with the ranked pre-knowledge scores also revealed no statistically significant differences in the mean rank scores ( $U = 720.00$ ,  $z = -1.08$ ,  $p = .278$ ) between the comparison arm ( $n= 37$ , *mean rank* 44.54) and the intervention arm ( $n=45$ , *mean rank* 39.00). Post intervention, there was a fall in the scores, but the comparison arms scores remained higher ( $n= 38$ ,  $M = 17.86$ ,  $SE = .21$ ) than the intervention arms ( $n= 40$ ,  $M = 17.58$ ,  $SE = .19$ ) with a mean difference of 0.29, 95% CI (-0.27, 0.86). The  $t$ -test analysis found no statistically significant difference in the pre-intervention scores ( $t_{(76)} = 1.04$ ,  $p = .302$ ) and, a very small effect size ( $d = 0.24$ ) was found. The Mann-Whitney  $U$  test also revealed no statistically significant differences in the mean rank scores ( $U = 619.50$ ,  $z = -1.45$ ,  $p = .147$ ) between the comparison arm ( $n= 38$ , *mean rank* 43.20), and the intervention arm ( $n=40$ , *mean rank* 35.99). Overall, the findings inferred that Sim-TDP did not have an effect on the participant's knowledge during any of the three phases of the study.

#### **5.2.6.3 – Mixed ANOVA on participant knowledge**

A mixed ANOVA was performed using the pre and post-knowledge scores as the within group variables and, the condition (intervention and comparison) as the between subject variable. This was undertaken to analyse the effect over time on the knowledge of participant's ( $N = 38$ ) in the Sim-TDP intervention arm ( $n = 14$ ) and those receiving the traditional SBE (Comparison) arm ( $n = 24$ ). This analysis indicated that there was no statistically significant differences in the knowledge scores ( $F_{(1, 36)} = 1.04$ ,  $p = .315$ ,  $r^2 = .17$  observed power = .17) (Figure 25). Levene's test was not significant; however,

Mauchly's test was statistically significant  $\chi^2_{(14)} = 36.04$ ,  $p = <.001$ . This was corrected using the Greenhouse-Geisser method with an  $\epsilon$  (Epsilon) of .73. The results showed that there was no statistical difference in the knowledge levels between the groups ( $F_{(3.68, 132.33)} = 1.83$ ,  $p = .132$ ) and, the effect size was small ( $r^2 = .17$ ) as was the observed power (.52).

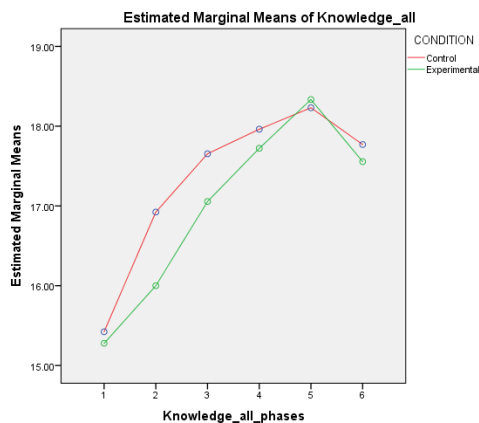


Figure 25:  
Knowledge  
mixed ANOVA  
scores

The findings inferred that Sim-TDP did not have an effect on the participant's knowledge overtime. Although not statistically significant, the mixed ANOVA identified a progressive rise in the participants scores overtime in both arms of the study, until the post knowledge scores in P3 where the scores for both arms fell (Table 32).

Table 32: Knowledge mixed ANOVA data

	Condition	Number	Mean	Standard deviation
P1 total knowledge pre	Comparison	26	15.42	2.30
	Intervention	18	15.28	2.37
P1 total knowledge post	Comparison	26	16.92	2.13
	Intervention	18	16.00	2.22
P2 total knowledge pre	Comparison	26	17.65	1.35
	Intervention	18	17.06	2.26
P2 total knowledge post	Comparison	26	17.96	1.75
	Intervention	18	17.72	1.49
P3 total knowledge pre	Comparison	26	18.23	1.03
	Intervention	18	18.33	1.28
P3 total knowledge post	Comparison	26	17.77	1.34
	Intervention	18	17.56	2.28

#### 5.2.6.4 – Multiple Regression on participant knowledge

##### 5.2.6.4.1 – Phase 1 analysis

The results were explored further using a multiple regression analyse. In P1, the dependent variable entered was the gain in knowledge of the participants and, a range

of demographic and SBE based independent variables were also entered. The variables were:

- Demographic predictors:
  - Age Group, with the dummy variables of:
    - Age 18 – 24 (Baseline)
    - Age 25 plus
  - Academic level, with the dummy variables of:
    - Advanced diploma (Baseline)
    - Degree
- Study predictors
  - Condition, with the dummy variables of:
    - Intervention groups
    - Comparison groups (Baseline)
  - Performance predictors
    - Total post-performance
  - Confidence predictors
    - Gain in self-efficacy Pre-Post intervention
  - Scenario predictors, with the dummy variables of:
    - Hypovolaemia (Baseline)
    - Asthma

The model generated did not have a significant  $F$  statistic ( $F_{(6, 68)} = 1.46, p = .206$ ), and, therefore, did not have a good fit, with no statistical significance in the ratio of the variability. Overall, only 4% ( $R^2 = .11, Adj R^2 = .04$ ) of the change in scores was predicted by the model. The analysis in terms of the difference between the

intervention and comparison arms found no significant effect on the Beta coefficients (Table 33). No other Beta coefficients were significant. However, a number of variables had large beta coefficients. The participants aged over 25 had an increase in their knowledge, in contrast to those of the baseline variable ( $\beta = .22$ , unstandardized Beta = 1.12). The intervention also had larger negative beta coefficients ( $\beta = -.26$ , unstandardized Beta = -1.18) that indicated a fall in the knowledge scores of the participants. This was also evident in the secondary analysis where the intervention arm had a small statistically significant negative correlation ( $r = -.23$ ,  $p = .025$ ,  $R^2 = .11$ ,  $Adj R^2 = .04$ ). Whilst the comparison arm had a small but statistically significant positive correlation ( $r = .23$ ,  $p = .025$ ,  $R^2 = .11$ ,  $Adj R^2 = .04$ ). No other independent variables had a statistically significant correlation.

Table 33: Phase 1 Beta coefficients, multiple regression – participant knowledge								
Predictor	Beta	SE B	$\beta$	t - Test	P	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	-1.25 (-6.42 – 3.91)	2.59		-0.49	.629			
Intervention	-1.18(-2.43 - .08)	.63	-.26	-1.87	.066	.21	.67	1.49
Age 25+	1.12(-.08 – 2.33)	.61	.22	1.86	.068	.21	.94	1.06
$R^2 = .11$ , $Adj R^2 = .04$								

The assumptions related to this analyse were met and the multi-collinearity diagnostics found no effects. The Durbin-Watson test was  $d = 1.95$  demonstrating that there was no autocorrelation. The findings inferred that Sim-TDP had a negative effect on the participant's knowledge, whilst their age, over 25 years, had a positive effect. The



intervention also appeared to have a negative correlation on the knowledge scores, although this was not causal.

#### **5.2.6.4.2 – Phase 2 analysis**

In phase 2, the dependent variable entered was the gain in knowledge during this phase and, a range of demographic and SBE based independent variables were entered which were:

- Demographic predictors:
  - Age Group, with the dummy variables of:
    - Age 18 – 24 (Baseline)
    - Age 25 plus
  - Academic level, with the dummy variables of:
    - Advanced diploma (Baseline)
    - Degree
- Study predictors
  - Condition, with the dummy variables of:
    - Intervention arm
    - Comparison arm (Baseline)
  - Performance predictors
    - Phase 2 total performance
  - Knowledge predictors
    - Phase 1 gain in Knowledge Pre-Post intervention
  - Self-efficacy predictors
    - Phase 2 gain in self-efficacy Pre-Post intervention

- Phase 2 scenario predictors, with the dummy variables of:
  - Sepsis
  - Chest pain (Baseline)
- Phase 2 preparation

The model generated did not have a good fit, since it had an  $F$  statistic of  $F_{(7, 40)} = 1.79$ , which was not statistically significant ( $p = .117$ ). Overall, less than 11% ( $R^2 = .24$ ,  $Adj R^2 = .11$ ) of the change in scores were predicted by the model. Although the model did not have a good fit, an effect was identified in relation to the age of the participants. The over 25 age group had a moderate statistically significant positive effect ( $F_{(7, 40)} = 1.79$ ,  $p = .117$ ,  $r = .38$ ,  $p = .004$ ,  $R^2 = .24$ ,  $Adj R^2 = .11$ ). This had a moderate positive correlation ( $r = .38$ ) between the actual age group and the gain in scores of the participants, which was significant at the  $p = .05$  level ( $p = .004$ ). The Beta coefficients (Table 34) indicated a rise in the scores in contrast to the comparison group baseline ( $\beta = .47$ , unstandardised beta = 1.56), which were statistically significant ( $p = .006$ ). The part correlation for this predictor was greater (.40) than the other predictor variables included in the model ( $p = .006$ ). There were no statistically significant Beta coefficients and, none of the independent predictors correlated with the participants gain in knowledge. The assumptions related to this analyse were met and, the multi-collinearity diagnostics performed found no effects. The Durbin-Watson test was  $d = 2.18$  and demonstrated no autocorrelation. The findings inferred that Sim-TDP had no effect on knowledge during this phase. The findings also inferred that the participant's age, over 25 years, had a positive effect on their knowledge scores.

Table 34: Phase 2 Beta coefficients, multiple regression – participant knowledge								
Predictor	<i>Beta</i>	<i>SE B</i>	$\beta$	<i>t</i> - Test	<i>P</i>	Part correlation	Tolerance statistic	Variance inflation factors (VIF)
Constant	3.52 (-.10 – 7.13)	1.79		1.97	.056			
Age 25+	1.56 (.46 – 2.65)	.52	.47	2.87	.006	.40	.70	1.43
$R^2 = .24$ , $Adj R^2 = .11$								

#### 5.2.6.4.3 – Phase 3 analysis

In phase 3, the dependent variable entered was the gain in knowledge and, a range of demographic and SBE based independent variables were entered. The variables were:

- Demographic predictors:
  - Age, with the dummy variables of:
    - 18 – 24 (Baseline)
    - 25 plus
  - Academic level, with the dummy variables of:
    - Advanced Diploma (Baseline)
    - Degree Level
- Study predictors
  - Condition, with the dummy variables of:
    - Intervention arm (Baseline)
    - Comparison arm
  - Phase 3 performance predictors

- Phase 3 post-performance total
- Phase 3 self-efficacy predictors
  - Phase 3 gain in self-efficacy Pre-Post intervention
- Phase 3 knowledge predictors
  - Phase 2 gain in Knowledge Pre-Post intervention
- Phase 3 scenario predictors, with the dummy variables of:
  - Myocardial Infarction (Baseline)
  - Anaphylaxis
- Phase 3 preparation

The model generated did not have a good fit, as it had an  $F$  statistic of  $F_{(7, 36)} = .54$ , and, was not statistically significant ( $p = .801$ ). Overall, less than 1% ( $R^2 = .10$ ,  $Adj R^2 = -.08$ ) of the change in scores was predicted by the model. The analysis found no significant effect on the Beta coefficients. On secondary analysis, the P2 gain in knowledge had a moderate statistically significant negative effect on the gain in knowledge of the participants in P3 ( $r = -.26$ ,  $p = .047$ ,  $R^2 = .24$ ,  $Adj R^2 = .11$ ). No other statistically significant correlations were identified. The assumptions related to this analyse were met and, the multi-collinearity diagnostics identified no correlations. The Durbin-Watson test was  $d = 2.44$ , which demonstrated no auto-correlation was present. The findings inferred that Sim-TDP had no effect on knowledge during this phase. Whilst the gain in knowledge in P2 had a negative correlation on the knowledge scores, although this was not causal.

### 5.3 – Chapter summary

In this chapter, the results of the various statistical tests were presented. The data was analysed following the five phase process outlined by Polit (2010a, p. 14) and assessed for missing data, outliers, bias and for any violations of assumptions. The results of these tests were varied. In relation to the performance of the participants, the mixed ANOVA found a statistically significant difference over the three phases in the post-performance mean scores of the intervention sub-groups.

A statistically significant result was also found in the independent *t*-test on the time on task of the participants in the intervention group in P1. This was, however, not sustained in either P2 or P3, although a large effect size was noted in P2, but only a negligible one in P3. During the individual phases both the independent *t*-tests and Mann-Whitney *U* tests found no statistically significant differences between the intervention and the comparison sub-groups. However, the paired *t*-test found a statistically significant difference between the pre and post-performance scores on the intervention group in P1, but once again, this was not sustained in either P2 or P3. Although a large effect size was noted in P2, but only a negligible one in P3.

A series of multiple regression analyses were undertaken on the performance of the participants with the models in the sub-group post-performance analyses, from all three phases, not having a good fit or, any statistically significant Beta coefficients. The multiple regression models on the individual participants' post-performance scores had a good fit and identified a number statistically significant Beta coefficients across all three phases. Unfortunately, due to the violation of assumptions during this test, I could only use the prediction of the independent variables scores. The multiple regression models on the gain in performance scores of the intervention arm in P1 and P2 did not

have a good fit and, were not statistically significant. However, the model in P3 did have a good fit and was statistically significant and, the main effects identified related to the actual SBE scenarios being used.

In relation to the self-efficacy scores, the mixed ANOVA found no statistical difference in the self-efficacy scores between the groups, which was also echoed by the independent *t*-tests and Mann-Whitney *U* tests in P1 and P2. However, in P3 the independent *t*-test was statistically significant. The multiple regression models did not present a good fit and, were not statistically significant. In relation to the knowledge scores of the participants, the mixed ANOVA found no statistically significant difference. A finding supported by the independent *t*-tests and Mann-Whitney *U* tests. The multiple regression models also did not have a good fit or any statistically significant Beta coefficients. In the next chapter, I discuss these findings in detail.

# Chapter Six - Discussion

## 6.1 – Chapter overview

In the previous chapter, the results of the data analysis were reported on the effects of the Sim-TDP model on the performance, self-efficacy and knowledge of the participants. This chapter explores these findings and, the impact of the Sim-TDP intervention on the performance, self-efficacy and knowledge of the participants. It critically analyses the findings in the context of the SBE, team and educational literature as well as significant theoretical frameworks relevant to the studies hypothesise, which were:

- 1)  $H_1$  - Following the introduction of Sim-TDP the adult nursing programme students in the intervention group would have significantly different mean scores in the post test than the comparison group with respect to their:
  - a. Performance ( $H_{1.1}$ )
  - b. Confidence/self-efficacy ( $H_{1.2}$ )
  - c. Knowledge ( $H_{1.3}$ )

$H_{01}$  - The null hypothesis being that following the introduction of Sim-TDP there would be no difference post-test between the adult nursing programme students in the intervention and comparison groups in relation to their:

- a. Performance ( $H_{01.1}$ )

- b. Confidence/self-efficacy ( $H_{01.2}$ )
- c. Knowledge ( $H_{01.3}$ )

2)  $H_2$  - The mean scores of the adult nursing programme students following each phase of the research study would differ significantly to those in the intervention group with respect to their:

- a. Performance ( $H_{2.1}$ )
- b. Confidence/self-efficacy ( $H_{2.2}$ )
- c. Knowledge ( $H_{2.3}$ )

$H_{02}$  - The null hypothesis being that the scores of the adult nursing programme students in the intervention group would not differ significantly following each phase of the research study in respect to their:

- a. Performance ( $H_{02.1}$ )
- b. Confidence/self-efficacy ( $H_{02.2}$ )
- c. Knowledge ( $H_{02.3}$ )

3)  $H_3$  - Following the introduction of Sim-TDP the time on task of the adult nursing students in the intervention group would be significantly different from the times of the comparison group.

$H_{03}$  - The null hypothesis being that following the introduction of Sim-TDP there would be no difference between the time on task of the adult nursing students in the intervention and the times of the comparison group.

The chapter concludes by making a number of recommendations for SBE practice and research.



## **6.2 – Performance discussion**

Over the three phases, the performance of the individual teams was assessed using the performance tool, which was then analysed at a sub-group level using a number of statistical tests. The results from the analysis were mixed and raised a number of points that warranted exploration in relation to the use of Sim-TDP and, the design and delivery of SBE to optimise participant performance.

### **6.2.1 - Simulation with team deliberate practice**

The analysis of the data was a major milestone in my doctoral journey and, the findings highlighted the potential of the Sim-TDP model as an SBE innovation. As stated by Ericsson (2004) the provision of opportunities for learners to practice was key to the implementation of DP and, to achieve this within a constructivist spiral curricula (Bruner, 1977), I designed an SBE strategy that progressively developed the skills of the students over year two of an adult nursing programme. At each phase, the scenarios aligned to the student's current stage of development (Ericsson, 2008; Vygotsky and Cole, 1978) with facilitator support that was based on the cognitive apprenticeship model (Woolley and Jarvis, 2007). The Sim-TDP model was introduced into this strategy with the hope that it would maximise the opportunities for students to engage in DP, whilst optimising their performance. In terms of performance, overall, the results inferred that this strategy had a positive effect. The mixed ANOVA identified that there was a statistically significant difference in the mean scores of the intervention arm compared to those of the comparison arm. Therefore, the hypothesis  $H_{2.1}$ , that the

performance mean scores of the participants in the intervention groups would differ significantly from those in the comparison groups, was accepted and the null hypothesis ( $H_{02.1}$ ) rejected. The results, further suggested that the intervention increased the performance scores over the course of the study with the intervention arm outperforming the comparison arm. As a result, the intervention met a key goal of DP, which was the achievement of continuous skill improvement (Bond et al 2008, McGaghie 2008, McGaghie et al 2010, and Motola et al 2013) and, the attainment of progressively higher levels of performance over time (Ericsson, Krampe, & Tesch-Romer, 1993; and Ericsson, 1996).

These findings were in line with the results of other DP studies in both nurse education (Barsuk et al., 2015; Liou et al., 2013; Oermann et al., 2011) and medical education (Barry et al., 2012; Barsuk et al., 2009; Butter et al., 2010; Joyce et al., 2015; Kessler et al., 2011; Kneebone and ApSimon, 2001; Knowles et al., 2013; Niles et al., 2009; Palter and Grantcharov, 2011; Pukenas et al., 2014; Reed et al., 2016; Sawatsky et al., 2013; Wayne et al., 2006). They were also consistent with the study by Whyte and Cormier (2014) on the use of DP in developing the more holistic skills of individual students in the recognition of the deteriorating patient. Furthermore, both Whyte and Cormier (2014) and Owen et al. (2017) recommended that longitudinal studies should be undertaken to ascertain the effect of DP on the performance of student's overtime and, my study, met their recommendations. In contrast to the study by Whyte and Cormier (2014), my study took place in a more natural curricula setting and not "laboratory based", with participants who were volunteers, therefore, the results highlighted the potential efficacy of Sim-TDP in a curricula.

In terms of the use of teams, the findings echoed the improvement in neonatal resuscitation performance that Sawyer et al. (2011) found in paediatric residents and,

that Abe et al. (2013) found in cardiovascular critical care nurses. Thus supporting the use of small teams in SBE and, the concept of shared or team deliberate practice (Baker et al., 2003; Baker and Young, 2014; Hodges et al., 2004; Lund et al., 2013b; Ward et al., 2007). As Pollock and Biles (2016) and Bland and Tobbell (2016) found, students reported that SBE gave them the opportunity to collaborate and learn from each other whilst also giving them the opportunity to learn about themselves in relationships with patients, their co-workers and peers. The results also supported the use of the Sim-TDP model, early in the career of undergraduate adult nursing students, in enhancing the quality of the taskwork and potentially the team working tracks of team training as, overtime, the participants' performance, as a team, improved. Sim-TDP enabled the participants to engage in deliberate team training activities to practice their taskworking skills whilst potentially develop their team working skill of coordination (Baker et al., 2006; Nadler et al., 2011). The addition of a coach to support the participants (Lund et al., 2013b) may also have avoided the problem of overloading the participants' cognitive processes by improving their ability to process information (Endsley, 2006, p. 649). Thus echoing the results of a number of studies exploring the use of the DP framework in team sports where effective performance depended upon the cohesive interaction among team members, gained through individual and team training (Baker and Young, 2014; Helsen et al., 1998; Lund et al., 2013b; Ward et al., 2007). This certainly warrants further exploration in terms of healthcare education.

As emphasised by Kardong-Edgren et al. (2015), finding the most impactful SBE methodology to learn, retain, and enhance learning was vital and, my study has made significant progress towards achieving this. The results inferred that the Sim-TDP model enhanced participant performance as it had a positive impact on the participant's performance. Therefore, would be of great interest to SBE educators and researchers.

A dearth of literature was identified in relation to the use of TDP in healthcare, therefore, in terms of the broader SBE literature, it adds to the growing evidence base of SBE and TDP research as it offers SBE educators a model that could be integrated in a wide range of professional undergraduate curricula. Potentially, it could also be adapted into a post graduate or insitu SBE programme, as the results also inferred that by using small teams of participants the Sim-TDP model achieved a balance between optimising performance and maximising SBE delivery and resources. The latter was achieved as the enhanced learning occurred within the same allotted time scale as traditional SBE thus, overcoming the challenges faced by SBE educators in delivering SBE including: the availability of SBE rooms and equipment; curricula time restrictions, and the availability of appropriately trained staff (Al-Ghareeb and Cooper, 2016; Aldridge, 2016). As professional nursing regulators and educational institutes explore replacing clinical practice with simulation this potentially would be of interest to simulation based educators in nursing. Thus the study offers a number of potential areas that could direct future SBE research and development.

Similarly, in terms of the broader team literature, my study adds to the body of team based healthcare literature and, in particular, its integration of this approach into an undergraduate curricula. As there was a dearth of healthcare literature on the application of TDP the study provides a template for the use of an event-based performance checklists (Rosen et al., 2011; Schmutz and Manser, 2013) to evaluate taskwork skills, including the use of a representative design approach (Brunswik, 1955b). Thus building on the work of Nadler et al. (2011). The results also indicated that by separating the two main elements of team training, taskwork and team work (Glickman et al., 1987; Rosen et al., 2008; Tannenbaum and Cerasoli, 2013), early in the careers of undergraduate adult nurses (Glickman et al., 1987; Mathieu and Rapp,

2009), Sim-TDP offers a potentially viable approach to developing their overall teamworking skills. An approach that could be developed across a range of professional programmes. Thus adding to the SBE team training literature.

### **6.2.2 - Time on task**

In relation to the effects that Sim-TDP had on the participants' time on task, the results indicated that in P1 the mean time on the post-performance data was shorter in the intervention sub-groups. Accordingly, in P1 the hypothesis H<sub>3</sub> was accepted. This was statistically significant and, had a large effect size, thus inferring that the intervention arm were quicker in achieving the scenario learning outcomes. This indicated that the response time of intervention arm to a deteriorating patient was faster than the comparison arm. The trend in reduced times continued in both P2 and P3, although they were not statistically significant. This inferred that Sim-TDP had its biggest, and most statistically significant, effect on the participants when they were at the novice end of their developmental continuum. An effect that would be of great interest to SBE educators, particularly those engaged in undergraduate education, and again would warrant further investigation.

Overall, Sim-TDP had a positive impact on the performance of the participants and, although contrary to a number of other studies (Kardong-Edgren et al., 2015; Luctkar-Flude et al., 2015), the results inferred an improvement in the detection of deterioration, especially early recognition, a skill vital to positive patient outcomes (The National Confidential Enquiry into Patient Outcome and Death, 2005; The National Institute for Health and Clinical Excellence, 2007; The National Patient Safety Agency, 2007).

Thus, adding to the weight of SBE evidence supporting the use of SBE as a learning and teaching methodology key to patient safety and the delivery of quality patient care. An approach that could aid SBE educators achieving professional competence in the recognition required by professional regulators, such as the NMC.

### 6.2.3 - Participant learning curves

In relation to  $H_{1.1}$ , there was no statistically significant differences between the intervention and the comparison groups during any of the individual phases thus  $H_{1.1}$  was rejected and,  $H_{01.1}$  accepted. Despite this, there was an increased effect size between P1 and P2, which reflected the mixed ANOVA findings for the post-performance scores. In P1, the mean scores in the base line pre-performance SBE were higher in the comparison arm, but this was not statistically significant. This indicated that the comparison arm's pre-performance was better than the intervention arms. This reversed following the Sim-TDP intervention and, though not statistically significant, it pointed to the possibility that the Sim-TDP model still had a positive effect on the performance of the participant's, especially as the Cohen's  $d$  test demonstrated a moderate effect size. This was echoed in the multiple regression analysis undertaken on the performance of the sub-groups. Despite no statistically significant Beta coefficients, the intervention led to an increase in the scores of participants, alluding to the potential impact of the intervention educationally. If one heeds the advice of [Field \(2013, p. 79\)](#) and [Hojat and Xu \(2004\)](#) and use the effect size as an indicator of the practical importance of research, as statistical significance itself does not convey the importance of a test, collectively, these point to the possibility that Sim-TDP enhanced participant performance and, in terms of delivering SBE in an existing curricula setting,

justifying its inclusion in the programme. Thus, adding further to the growing evidence base of SBE, team and TDP research and as such, offers SBE educators a model that could be integrated in a wide range of professional undergraduate curricula, whilst providing a number of potential areas that could direct future SBE research and development.

In P2, the mean scores of the intervention group remained higher and, although not statistically significant, there was a gain of five points in the mean score, with a large effect size that indicated an enhanced performance over time. The sub-group multiple regression analysis also found, although there were no statistically significant Beta coefficients, that following the intervention there was an increase of 11.01 in the scores. This was also echoed in the P2 multiple regression analysis on the individual post-performance scores of the intervention arm. Further suggesting that there was an improvement in performance during this phase and, between P1 and P2, which was very encouraging in terms of the educational impact of the intervention. However, this trend did not continue in P3. In parallel with the time on task, the scores appeared to rise over the initial two phases and then level off in P3.

When explored further, one possible explanation related to the development of professional expertise and the progression from novice to expert (Dreyfus et al., 1986; Dreyfus, 2004). A model that has been successfully applied by Benner (2001, p. 13) to the acquisition of clinical skills by nurses. As Lammers et al. (2008) noted, the acquisition of skills occurs at a regular rate and, when plotted against time, a learning curve can be produced. Initially, a learner moves up the learning curve rapidly but, with repeated practice, the rate of learning begins to slow resulting in less learning and, the amount of performance improvement gained decreases (Pusic et al., 2011). This was

reflected in my study. The intervention arm had a rapid increase in their mean scores over P1 and P2, which then fell in P3. This was further evidenced in the intervention sub-groups' paired *t*-test results, which in P1, were statistically significantly higher post-performance, with a very large effect size. This continued in P2 but at a slower rate and, although the effect size was large, it was not statistically significant. In P3, the scores appeared to level off, with no statistical significance demonstrated and, the effect size was negligible.

Conversely, the comparison arms' mean scores appeared to increase more gradually until P3 where they were just below those of the intervention arm. Thus, the Sim-TDP intervention appeared to accelerate the learning curve of the participants transferring the steep portion of the learning curve to the SBE environment (Lammers et al., 2008) and, as a result, optimising participant performance. It could, therefore, be inferred that Sim-TDP enabled participants to apply their learning in a realistic clinical situation, an approach consistent with the active experimentation phase of Kolb's experiential learning cycle (Kolb, 2015, p. 51). This was contrary to the findings of Elfrink et al. (2009) who, in their evaluative study found, that nursing students reported that repeating the scenarios hindered their learning. Unfortunately, the authors did not observe or actually measure the participant's performance making direct comparisons very difficult.

When analysing the mixed ANOVA results, the sub-groups pre-performance data, there was no statistically significant difference over the three phases, which were in fact very similar. Despite the increased scores following the Sim-TDP intervention, they dropped back down to a similar level to that of the comparison arm. Although the rise in



the post-performance scores in the intervention arm was statistically significant, the effect itself appeared to be short lived. This added further to the suggestion that the two groups had different learning curve trajectories, with the intervention arm having an accelerated and steeper learning curve, but with a rapid fall or decay following the intervention. In contrast, the comparison arm had a relatively flatter curve. A number of authors have also found this phenomenon (Hashimoto et al., 2015; Prat et al., 2016). Hashimoto et al. (2015) in a randomised control study found that their DP training programme resulted in their experimental group reaching a higher plateau level (Global Rating Score of 25 ( $F_{1,158} = 73.7$ ,  $df = 159$ ,  $p = 0.001$ ) than the control group (Global Rating Scale of 20 ( $F_{1,138} = 49.9$ ,  $df = 139$ ,  $p = 0.001$ )). Although the sample size was small, the findings reinforced the results of my study. The findings also led Hashimoto et al. (2015) to suggest that the control group entered a state of arrested development. A number of authors have suggested that this happens when an interruption or reduced engagement in the process of DP occurs (Ericsson, 2004; Ericsson, 2008; Ericsson et al., 2009; Lund et al., 2013b). In terms of my study, this seemed to be true for the comparison arm who appeared to be in a flatter, set trajectory, whilst the intervention arm not only had an accelerated learning curve Sim-TDP also appeared to prevent them from becoming locked into a set trajectory. An effect recognised by Pusic et al. (2012) in their review of the use of experience curves in healthcare education. However, this did not explain the fall or decay in the intervention arms' post-performance scores to levels similar to those in the comparison arm. Unfortunately, Hashimoto et al. (2015) did not give the time frame between the cases making comparison difficult.

Outside the healthcare arena, this effect had also been noted by other professions. Chatham (2009, pp. 27-60) in his review of military training in the Twentieth Century,

reported that the performance levels of fighter pilots following a period of enhanced training decayed after two to three months and, these dropped back to the pilot's pre-performance levels. He also noted that following a refresher training programme their performance levels once again returned to the levels they had immediately following the enhanced training (Chatham, 2009, pp. 27-60). This pattern was evident in my results, with an initial rise in the intervention arms scores that was followed by a fall at three months. This fall, or decay, could be plotted as a curve with the slope dependent on the length of time between episodes of training (Chatham, 2009, pp. 27-60; Jaber and Bonney, 1996) and, if not practiced, this decay could occur at a startling rate (Pusic et al., 2012). The decay in performance has been well documented in the resuscitation literature where a number of studies found a reduction in the skills of both qualified healthcare practitioners (Braun et al., 2015; Nelissen et al., 2015; Niles et al., 2009; Smith et al., 2008) and pre-registration/undergraduate students (Aqel and Ahmad, 2014; Madden, 2006; Oermann et al., 2011; Oermann et al., 2014).

To avert this, Braun et al. (2015) recommend that, after a single SBE session, relatively frequent refresher training should be used. They found that following a paediatric SBE based DP programme the performance of participants ( $N = 42$ ) degraded over time, which was significant ( $p = 0.039$ ), with 92% retaining mastery at two months, 71% at four months, and 56% at six months. Therefore, in my study, to maintain their enhanced level of performance and, prevent any skills decay, the intervention arm required an increase in the frequency of SBE scenarios. To prevent a piecemeal approach to skill development this should as, advocated by Pusic et al. (2012), be based on a framework centred on development over time. A number of approaches were apparent in the literature, including sessions repeated twice per month (Niles et al., 2009), monthly (Oermann et al., 2011; Oermann et al., 2014) and every two months

(Braun et al., 2015) but, no definitive framework was evident. Niles et al. (2009) recommended the twice-monthly approach after finding that the time taken to achieve proficient resuscitation skills was significantly less at this point ( $n = 10$ , median 21s, IQR: 15.75–30 s). Oermann et al. (2011) found, that monthly CPR practice improved the performance of nursing students ( $N = 606$ ).

Pusic et al. (2012) following their review of learning and decay curves in radiography education, posited that regular DP could prevent skills decay, but they did not offer a strategy to achieve this. However, using the basic concepts in pharmacology, Weinger (2010) described a contextual framework that SBE educators could adopt based on the pharmacokinetics and pharmacodynamics of drug treatments. This included an initial dose followed by scheduled doses (Weinger, 2010). He related the dose-effect curves that occurred following drug administration to those of the learning and the decay curves of learners and recommended that healthcare educators, to optimise learning, should embrace the same principles. In relation to scheduled doses, a number of authors have advocated the use of either spaced education (Carpenter et al., 2012; Kerfoot et al., 2007), or distributed practice (Cepeda et al., 2009). Approaches that used multiple study sessions, that were spaced apart in time, rather than being massed together (Rohrer, 2009) with an optimal spacing gap between the sessions of 10–20 % of the test delay (Carpenter et al., 2012), or potentially, the gap between SBE scenarios. Relating this to my study, as the SBE sessions were delivered every three months, or twelve weeks, the optimal time would be three weeks after each delivery.

In terms of the initial dose, Paige et al. (2009) used a technique that allowed qualified inter-professional teams to undertake two different SBE scenarios in sequence on the

same day and, then repeated them six months later. They found that this approach improved the participant's self-efficacy scores and attitudes towards team working. Using the same approach but, teaching team-based competencies, Garbee et al. (2012) found that participants' performance showed a significant increase from the first scenarios to the second set ( $p < .05$ ). They concluded that this approach improved both the participants' perceived and actual team-based competencies, which they retained over time. They also posited that their findings supported the use of repeated sessions over a six month period, which provided some evidence for the increased faculty time and effort (Garbee et al., 2012). In another study, Jiang et al. (2011) found an improvement in the performance of fifth year medical students ( $N = 52$ ) in performing thoracentesis following five DP sessions, over a two week period. In terms of their learning curves, their performance plateaued after the fourth DP session and, this level was subsequently maintained at six months and then at one year.

Collectively, these studies point to the benefits of having a number of SBE sessions following an initial loading dose to maintain performance levels; thus raising a potential solution to the decay observed following the Sim-TDP intervention and, one that would warrant further study into its use to optimise performance. Thus, the study not only adds further to the growing evidence base of SBE, team and TDP research but, the discussion provides an intriguing insight into the effective instructional designs. As such, it offers SBE educators a model that could be integrated in a wide range of professional undergraduate curricula, whilst providing a number of potential areas that could direct future SBE research and development into the most effect instructional design features that optimise performance.

#### **6.2.4 - Participant cognitive load**

The fact that the mean scores on both arms in P3 fell warranted further exploration as to why, especially as healthcare SBE has often been described as being highly complex (Fraser et al., 2015; Meguerdichian et al., 2016). Therefore, as advised by Spruit et al. (2014), had I taken sufficient steps to prevent the participants from becoming overwhelmed and not increased the complexity of the skills gradually (Lammers et al., 2008). I had adopted this approach in the SBE strategy, which aimed to engage the participants in increasingly challenging tasks over time, so that they could attain higher levels of performance that exceeded their initial level of performance (Ericsson 2006, p694, and 2008). This raised the question as to whether this approach had been effective. The approach was based on the assertion by Cook et al. (2012), in a meta-analysis, that it was the use of strong instructional design features, rather than the actual SBE scenario itself, that was associated with higher learning outcomes. This was particularly so for skill and behaviour type outcomes and, they identified a number of design features that were key to achieving this, including enhanced feedback, increased time learning, group work, and lower extraneous cognitive load (Cook et al., 2012).

Reflecting on the Sim-TDP model, I noted that it incorporated the first three of these design features, especially as the feedback occurred in groups and, that the participants were exposed to a longer overall debrief that led to an increased learning time. I had, however, not considered the fourth feature: extraneous cognitive load. This had been described as one of the three elements central to cognitive load theory (CLT) (van Merriënboer and Sweller, 2010; van Merriënboer and Sweller, 2005) and, key to understanding human cognitive architecture (Fraser et al., 2015; Meguerdichian et al., 2016). Both Fraser et al. (2015) and Meguerdichian et al. (2016) recommended that all

healthcare educators should consider CLT when developing their educational activities, which I had not. CLT considers the features, scope, limits, and possibilities of the way human beings interact with the world around them when they are engaged in learning (Reedy, 2015). As this process occurs in the working memory it has a limited capacity and can only handle three or four meaningful elements (Cowan, 2014). Therefore, for learning to take place any new information has to be sent from the working memory to the long-term memory to be encoded, indexed, and stored for later use (Reedy, 2015). Reviewing this further, I found that there were three elements that facilitated this process, the first of which, intrinsic load, represented the inherent difficulty of the task. The second, extraneous load, related to those elements that did not directly relate to the task and, finally, germane load, which related to the storing of the encoded information, as schema, within the long-term memory (van Merriënboer and Sweller, 2010; van Merriënboer and Sweller, 2005).

In practical terms, Meguerdichian et al. (2016) identified how this affected how experts and novices behaved when they solved problems. Experts, they posited, addressed problems by utilising existing schema and, as a result, used less mental effort, whereas novices had to develop new schema that required greater mental effort. When this mental effort reached a level that overloaded the working memory, it prevented schema from being developed and, as a result, stopped learning from taking place (Leppink and van den Heuvel, 2015). This problem could occur for several reasons, firstly, when a task was too difficult for a learner's current stage of development it increased intrinsic load above their working memory capacity. Secondly, it could occur when there were too many superfluous elements interacting in the teaching session that could lead to an increase in extraneous load. The working memory would, therefore, become overloaded, resulting in the learners being unable to develop schema that would

facilitate germane load and, lead to learning taking place (Leppink and van den Heuvel, 2015; van Merriënboer and Sweller, 2010; van Merriënboer and Sweller, 2005).

In light of this, I reviewed the design of the P3 scenarios which, were centred on the principles of constructive alignment and thus, based on the programme and module learning objectives (Biggs et al., 2011, p. 97). These included developing an awareness of the emergency algorithms for a) anaphylaxis (The Resuscitation Council (UK), 2015c) and, b) cardiac arrest (The Resuscitation Council (UK), 2015b). By deliberately aligning the SBE scenarios with the learning objectives, over year two, I aimed to enhance the participant's understanding of the deteriorating patient. This meant reserving the more complex SBE activity for the final SBE scenarios. This would reduce the cognitive load on an individual and share the mental effort across the team (Cook et al., 2012; Kirschner et al., 2009a; Kirschner et al., 2009b; Reedy, 2015).

During my review, I found a number of possible explanations for the drop in P3 scores that related to CLT. The first of which was the expertise reversal effect. This phenomenon was noted by van Merriënboer and Sweller (2010) who described it as an instructional method that worked well for a novice learner, but would, once they had gained more experience, actually have no effect on their learning or worse still, an adverse effect. Fundamentally, the benefits of an instructional design aimed at supporting a novice learner would be lost or would become detrimental when they had become more proficient in the task they were being taught (Leppink and van den Heuvel, 2015). This offered a potential explanation for the drop in the P3 scores since both the SBE approaches, especially Sim-TDP, supported the participants in P1 and P2. However, once they had reached P3, due to them potentially developing greater proficiency, the SBE approaches were less effective.

A second possible explanation related to the actual scenarios being too complex. The introduction of the algorithms to the scenarios in P3 was new and, consequently comprised of more elements. This could have imposed a higher level of intrinsic load on the participants and, as they were still developing new schema, could have led to their working memory becoming overloaded, thus hindering their learning (Leppink and van den Heuvel, 2015). Although the sub-group multiple regression analysis in P3 found no statistically significant Beta coefficients, the secondary analysis found that the myocardial infarction scenario had a large negative correlation with the sub-groups' post-performance scores. Although no causal effect could be concluded from these results, the negative relationship could have been related to the design of the scenarios. Other authors have acknowledged the increased cognitive load that SBE generates in both nursing students (Schlairet et al., 2015) and medical students (Fraser et al., 2012; Haji et al., 2015).

Exploring this further, Guadagnoli et al. (2012) theorised that learning could be plotted against the difficulty of a task and, subsequently, a learning curve generated, which they termed as the Challenge Point Framework (CPF). They suggested that as the difficulty of a task increased so did the learning, until an optimal challenge point was reached. This, they posited, was where the learner was optimally challenged and, as a result, efficient learning took place but, beyond this point, performance decreased with the increased complexity of the task (Guadagnoli et al., 2012). As Guadagnoli et al. (2012) noted, the challenge point varied depending on what stage the learner was at, with a novice learner having a lower point than a more experienced individual. They recommended that educational activities should be designed to maintain an appropriate task difficulty. In relation to my study, the addition of the algorithms added a greater level of difficulty to the task that increased their complexity. This not only added to the intrinsic load of the scenario, but it pushed the participants beyond their



optimal challenge point, causing a reduction in their learning. Although the scenario designs met the brief of the module learning outcomes it could be inferred that they were poorly designed and, as a result, hindered the participants learning.

Another potential factor that needed to be taken into account was the emotional load that the scenarios generated on working memory. Kaddoura et al. (2015) reported that, following multiple SBE scenarios, novice nursing students felt overwhelmed.

Unfortunately, as Fraser et al. (2012) noted, there has been very little CLT research conducted into the effects of SBE within the affective learning domain and its impact on working memory. A number of studies have identified that immersive SBE has evoked fear and anxiety in students (Bland and Tobbell, 2016; Burbach et al., 2016; Pollock and Biles, 2016) and they speculated that this could reduce performance (Elfrink et al., 2009; Mills et al., 2016). This warrants future investigation. In exploring the effects of Sim-TDP this discussion unearthed a number of potential factors that could affect the participant's performance such as cognitive load theory and the challenge point framework. Once again the debate provides an intriguing insight into effective instructional designs. These areas are relatively new to the SBE field and, as such, warrant further study not only in relation to SBE, Team training and TDP but also in the broader healthcare education arena. In essence, exploring their impact on other learning and teaching methodologies. Thus the discussion offers a number of potential areas to guide future healthcare education research into the most effective instructional design features that optimise learning.

#### **6.2.5 – Scenario sequencing and representative design**

A common theme throughout the phases was the effect of the actual scenarios on the participants' post-performance scores across both the intervention and comparison arms of the study. The scenario choice e.g. asthma or chest pain was governed by the overall programme and module learning outcomes and, was aligned accordingly. The multiple regression and secondary analysis in P1 inferred that the asthma scenario had a moderate positive correlation producing a rise in mean scores. In contrast, the hypovolaemia scenario had a large negative correlation and produced a fall in the post-performance scores. This was an intriguing result, as I had not factored in the impact these would have on the participants' learning during the design process, having relied on the programme and module learning outcomes as a guide.

When I investigated these results further, I noted that Brunswik (1955a) in his theory of probabilistic functionalism had identified that learners take cues from their environment to aid their decision making processes. Across the study, the number and the nature of cues that the participants had to cognitively process varied between the individual scenarios, which were heavily governed by the clinical condition they focused upon. In the asthma scenario, the clinical cues, such as the audible wheeze were very explicit, whereas the cues in the hypovolaemia scenario were much more subtle in nature e.g. pallor and urine output and, there were a greater number of them. Additionally, more of the cues in this latter scenario could be related to a number of clinical conditions e.g. increased respiratory rate and tachycardia could be due to respiratory or cardiac condition or pain, adding more complexity to the scenario. These findings were counter to the results reported by Guhde (2011) who found no difference between her students self-reported perceptions of their critical thinking ability and the level of complexity of the scenarios. However, these findings would have to be viewed with caution as she firstly, did not observe the impact of the scenarios on the students actual performance and, secondly, she used self-reported levels of performance, which have been

identified as being unreliable (Davis et al., 2006 ). Although other authors (Garrett et al., 2011; Schlaieret, 2011; Shin et al., 2015a) have pointed to the positive learning that could be achieved by using complex scenarios both Yang et al. (2012, ) and Yang et al. (2013) found that increased complexity, or representative design, was associated with a reduction in the accuracy of the clinical judgments being made.

Yang et al. (2013) found that nurses' judgements during SBE were significantly less accurate than when they used paper-based scenarios. Although the authors did not discuss cognitive load theory, they postulated that their findings were due to an increase in the representative design features of the scenarios. Whilst this resulted in more realistic clinical cues, the consequence of this resulted in the participants only being able to perceive a smaller number. In my study, the inherent complexity of the individual P1 scenarios and the variation in the number of cues that the participants had to process, potentially increased their intrinsic load and affected their performance. This was also evident in the other phases of the study. In P2, the effect of the sepsis scenario was to cause a rise in the scores. Whilst the chest pain scenario demonstrated a fall in post-performance scores. In P3, the anaphylaxis scenario caused a rise in the scores whilst the myocardial infarction scenario caused a fall in the P3 post-performance scores. This highlighted the need to set the scenario and, its sequence, to the correct level to ensure effective learning takes place (Ericsson, 2004; Ericsson, 2015; McGaghie et al., 2006; Vygotsky and Cole, 1978).

In the multiple regression analysis on the gain in the scores of the participants in the intervention arm appeared to paint a different picture. Although the models generated in all phases were not statistically significant, the asthma scenario in P1 caused a smaller gain in the participants' scores, whilst the hypovolaemia scenario caused a

greater gain in the scores. This effect was not observed in P2 but, in P3, the anaphylaxis scenario caused a smaller gain in the participants' scores, whilst the myocardial infarction scenario caused a greater gain in the scores. The net result appeared to be that the asthma scenario had a beneficial effect on the participants in P1 but caused the least gain in the scores of the intervention group. Whilst the hypovolaemia scenario had the least benefit, it caused the greatest gain in scores. In P2, the sepsis scenario had a beneficial effect on the participants as opposed to the chest pain scenario; however, these did not influence the gain in scores of the intervention group. Whereas the anaphylaxis scenario in P3 had the greatest beneficial effect in this phase, it caused the least gain in scores in the intervention arm groups. The myocardial infarction scenario was least beneficial in terms of the post-performance results but did cause the greatest gain in scores of the intervention arm.

These findings posed a conundrum and, at first glance, the hypovolaemia, chest pain and myocardial infarction scenarios appeared to generate the greatest learning in the participants, even though the other scenarios produced the highest scores. In terms of the learning curves of the participants in the intervention arm, it could be inferred that the asthma, sepsis and anaphylaxis scenarios were higher on the participants' learning trajectories and, therefore, closer to their CPF. As a result, the lower gain in scores reflected their approach to the flatter portion of the curve and, therefore, these were set closer to their current level of ability. Conversely, the remaining scenarios were at a lower level on the learning curve and, as a result, it could be inferred that the learning outcomes for these scenarios were set inappropriately.

The sequencing of the scenarios, therefore, appeared to influence the participants' performance and, as a result, careful consideration should be made about how and when different scenarios should be introduced into a programme. Reliance solely on

the programme and module learning outcomes to guide the sequencing should be avoided. Instead, consideration should be given to the actual content of the scenario and its appropriateness to the level of the learner when planning programme curricula and modules. The challenge for nurse educators using SBE would, therefore, be to identify and design representative tasks that allowed learners to perform consistently under standardised conditions (Ericsson, 2009) and, then to ascertain the correct scenario and, set of representative tasks, for the various stages of a learner's development. This warrants further study and should be a key area for future research. Once again, in exploring the effects of Sim-TDP this discussion, like the discussion on cognitive load, has uncovered a number of potential factors that could affect the participant's performance such as the sequence of scenarios and representative design. Thus raising the need for effective instructional designs. Although my study does not provide any definitive findings, the discussion is speculative in nature, the provision of effective design features warrants further study. Again not only in relation to SBE but also in the broader healthcare education arena. Thus the discussion offers a number of potential areas to guide future healthcare education research into the most effective instructional design features that optimise learning.

#### **6.2.6 - Performance summary**

Overall, it could be inferred that the Sim-TDP model had a positive effect and potentially achieved a balance between maximising delivery and optimising participant performance. Although there was no statistically significant differences between the intervention and the comparison groups during any of the individual phases of the study, the results of the mixed ANOVA supported the introduction of Sim-TDP as an innovative learning and teaching approach. They identified that there was a statistically

significant difference in the mean scores and inferred that Sim-TDP achieved a key objective of DP, which was the development of skills over time. The greater effect sizes that the intervention generated were also very promising and alluded to the beneficial effect of the Sim-TDP model, thus supporting the use of small teams in SBE and, the concept of shared or team deliberate practice. Sim-TDP also had a statistically significant effect on the time on task in P1, inferring that the participants in the intervention arm were quicker in achieving the scenario learning outcomes. This trend continued in both P2 and P3 but they were not statistically significant.

The overall positive inferences of the results I feel add to the growing evidence base of SBE, team training and TDP as it offers SBE educators a model that could be integrated in a wide range of healthcare educational programmes at an undergraduate or post graduate level, or in simulation centres or in actually insitu. Thus the study offers a number of potential areas that could direct future SBE research and development. Sim-TDP has the potential to provide a balance between optimising performance whilst maximising SBE delivery and resources. This, therefore, would be of great interest to SBE educators and researchers, especially as a dearth in the literature was identified in relation to the use of TDP in healthcare and, as professional nursing regulators and educational institutes explore replacing clinical practice with simulation. As the results also inferred, an improvement in the detection of deterioration, especially early recognition, a skill vital to positive patient outcomes they add to the growing SBE evidence supporting the use of SBE as a key educational strategy for patient safety and the delivery of quality patient care and, therefore, an approach that would of great interest to SBE educators in relation to professional competence and professional regulation.

In the process of analysis, I discussed a number of issues that affected the performance of the participants related to the actual design of the Sim-TDP intervention and SBE generally. This encompassed the effect of Sim-TDP on the learning and decay curves of participants and its potential ability to prevent a state of arrested development or, of the participants becoming locked into a given trajectory. This discourse also included the effect of Sim-TDP on the cognitive load of participants and the need to identify their optimum challenge point. I also raised a number of issues regarding the delivery of Sim-TDP and SBE, including the need to apply the representative design features of individual scenarios effectively and to consider which order or sequence these should be delivered. The effect of the gap between SBE sessions was also raised and by using the concepts of spaced education and distributed practice to set the timing of repeated sessions participant learning could be optimised and performance decay reduced. I recommended more research studies aimed at identifying the appropriate SBE approaches to use at different educational stages (Yuan et al., 2012), including more robust SBE versus SBE studies aimed at identifying SBE design features that enhanced learning (Cook et al., 2011a). In exploring the effects of Sim-TDP this section of the chapter uncovered a number of potential factors that could affect the participant's performance thus highlighting the need for effective instructional designs. Although my study does not provide any definitive findings, the discussion is speculative in nature, the provision of effective design features warrants further study. Again not only in relation to SBE but also in the broader healthcare education arena. Thus this section offers a number of potential areas to guide future healthcare education research into the most effective instructional design features that optimise learning.

### **6.3 - Self-efficacy discussion**

Over the three phases, I assessed the perceived self-efficacy of the individual participants using the self-efficacy tool and analysed the data using a number of statistical tests. This was measured at the individual level. The results from the analysis were mixed and raised a number of points that warranted exploration.

### **6.3.1 - Self-efficacy and simulation with team deliberate practice**

Starting this exploration with the multiple regression analysis, the self-efficacy data did not identify any statistically significant predictor variables. However, in P3 the preparation that the participants undertook, had a positive predictor effect on self-efficacy scores across both arms of the study. This was supported by the secondary analysis that found a small to moderate positive statistically significant correlation with their self-efficacy gains. This alluded to the participants seeking out additional learning opportunities and, as Chee (2014) suggested, linked to increased motivation, a central attribute of DP theory (Ericsson et al., 1993; Ericsson et al., 2009; Ericsson and Neil, 1994). It could be inferred, therefore, that Sim-TDP potentially supported increased the participants' motivation. When I explored the remaining components of the DP framework (Ericsson, 2004), especially the effect over time, the mixed ANOVA analysis found no statistical significant difference in the pre and post-intervention mean scores between the intervention and comparison arms. This led me to reject the hypothesis  $H_{2.2}$  and, accept the null hypothesis  $H_{02.2}$  that the scores in the intervention group would not differ significantly following each phase of the research study. This finding was in line with other DP focused SBE studies (Kessler et al., 2011; Ortner et al., 2014) that found that despite increased confidence levels, there was no statistically significant difference between their comparison and intervention groups. My study, therefore,



adds to the debate on the effects of DP focused SBE on self-efficacy and, further studies would be warranted into this area.

This mixed effect in the findings was evident in the results from the *t*-tests and Mann-Whitney *U* tests. In P1 and P2 there was no statistically significant difference between the mean scores of the arms and this led me to reject the hypothesis  $H_{1.2}$  and, accept the null hypothesis  $H_{01.2}$  for these phases. Once again, these results were in line with the findings from other studies that found no statistically significant differences in the confidence/self-efficacy scores in either undergraduate nurses (for example Brannan et al., 2008; Frehner et al., 2012; Hoadley, 2009; Kardong-Edgren et al., 2008; Lee et al., 2016; Merriman et al., 2014; Stayt et al., 2015), post qualified nurses (Arnold et al., 2011; Hoadley, 2009) or, in their perceptions of self-efficacy (Pike and O'Donnell, 2010). This also resonated with studies in the medical SBE literature (Barsuk et al., 2009; Bender et al., 2014; Kessler et al., 2011).

This was, however, in direct contrast to the P3 findings. In this phase, the *t*-tests found statistically significant differences between the two arms of the study. Prior to the intervention, the comparison arm had a statistically significant higher score than the intervention arm. This could be attributed to the fact that a large number of the participants in the intervention arm had not undertaken the P2 scenarios, which invariably led to a longer gap between their scenarios. As a result, this could have adversely effected their self-efficacy scores, especially if you take into account that confidence declines at a rate dependant on the length of time between episodes of training (Chatham, 2009, pp. 27-60; Jaber and Bonney, 1996; Lammers et al., 2008; Pusic et al., 2012). However, the comparison arms scores remained statistically significantly higher post-intervention. This, once again, could have reflected the continuing impact of the missed SBE session on the intervention group, but this result

echoed other studies where a statistically significant positive effect on participants was found in both undergraduate nurses (for example Ahn and Kim, 2015; Basak et al., 2016; Buykx et al., 2011; Cummings and Connelly, 2016; Goldenberg et al., 2005; McCabe et al., 2016; Nelissen et al., 2015; Omer, 2016) and post qualified nurses (Abe et al., 2013; Buykx et al., 2011; O'Leary et al., 2016). A result, that had also been reported in a number of qualitative nursing studies (for example Moule et al., 2008; Reilly and Spratt, 2007; Stirling et al., 2012; Sundler et al., 2015) and systematic reviews (Boling and Hardin-Pierce, 2016; Cant and Cooper, 2010). This increase in confidence had also been reported in a number inter-professional SBE studies (Alinier et al., 2008; Baker et al., 2008; Liaw et al., 2014) and also within the medical literature (Brown et al., 2012; Hogg and Miller, 2016).

The mixed results in my study echoed the clear dissonance in the SBE literature on the effects of SBE on participant confidence/self-efficacy. Not surprisingly, this discord was also found in a number of systematic reviews (Lapkin et al., 2010; Laschinger et al., 2008a; O'Donnell et al., 2014; Weaver, 2011b; Yuan et al., 2012). When explored further, the pre-post design nursing studies that reported no statistically significant gains in the confidence/self-efficacy (Alinier et al., 2006a; Alinier et al., 2004; Arnold et al., 2011; Hoadley, 2009; Lee et al., 2016; Liaw et al., 2012; Merriman et al., 2014), either compared SBE with different learning and teaching methodologies or, compared SBE with other SBE designs. What was noteworthy in the studies that reported positive gains in confidence/self-efficacy, was the fact that, with the exception of Jeffries and Rizzolo (2006) and Ahn and Kim (2015), all the other studies focused on the effect of SBE alone and did not include a comparison group (Abe et al., 2013; Bambini et al., 2009 ; Burns et al., 2010; Buykx et al., 2011; Cummings and Connelly, 2016; Goldenberg et al., 2005; Mould et al., 2011; Nelissen et al., 2015). This suggests that a positive effect occurs with any learning experience regardless of the learning and

teaching methodology used because when SBE has been compared to other approaches there was no difference in the effect between methods.

The positive impact of any educational intervention on self-efficacy/confidence was demonstrated by Roh et al. (2014) in their study using a pre-post design to evaluate the effectiveness of an integrated SBE training programme. They compared three approaches, the first of which was a sole two-hour SBE session, the second a two-hour SBE session with clinical observation and finally, a two-hour SBE session with a clinical placement. 255 second-year nursing students participated in the study and the authors found that there was no difference between the three designs (Roh et al., 2014). This was evident in the current study where no statistically significant differences were found between the two SBE approaches in P1, P2 and over time. As a number of authors have suggested, the increase in confidence may have been because the participants were undertaking educational experiences in a safe learning environment (Pollock and Biles, 2016; Weaver, 2011a; Yuan et al., 2012). An area that warrants further investigation. Overall the mixed results I feel only added to the dissonance in the SBE literature generally. Nevertheless this should not dissuade SBE educators and researchers from investigating this further so that a clear picture into the cause and effect of SBE on confidence/self-efficacy can be ascertained. The study offers a number of potential areas that could direct future SBE research and development.

### **6.3.2 - Self-efficacy and cognitive load**

Confidence has been recognised as vital to the acquisition of clinical skills and, consequently, for the provision of safe effective patient care as low levels present a barrier to learning (Hecimovich and Volet, 2011; Leigh, 2008; Lundberg, 2008). One possible explanation for the mixed results was that, as novice practitioners, the

participants were still at the lower end of the confidence continuum (Andreatta and Lori, 2014, p. 32). As detailed by Andreatta and Lori (2014, p. 32), a novice learner does not possess much confidence in their abilities, which could account for the low self-efficacy in the early phases of the study. However, as the participants moved through the study and along the confidence continuum towards an intermediate level, it would be expected that they became more confident (Andreatta and Lori, 2014, p. 32). This appeared to be the case for the participants in the comparison arm but, it was not evident in the intervention arm where the results suggested that the traditional approach to SBE was more effective in developing self-efficacy. This increase in self-efficacy, however, occurred at a time when the knowledge and performance scores of both arms dropped post-intervention. As the complexity of SBE can naturally contribute to cognitive overload (Josephsen, 2015) this raised the possibility that the inclusion of a second scenario led to a higher cognitive load, which overloaded the participants (Leppink and van den Heuvel, 2015; van Merriënboer and Sweller, 2010; van Merriënboer and Sweller, 2005) and led to a reduction in their confidence/self-efficacy (Yang et al., 2012, ; Yang et al., 2013). This discussion, although speculative, should be of great interest to SBE educators and researchers as this could potentially impact on the efficacy of SBE as a learning and teaching methodology. As this area is relatively new to the SBE arena it has not been investigated in any this offers a number of potential areas for future SBE research and development.

### **6.3.3 - The effectiveness of self-efficacy reports**

Exploring this further, in terms of competency, knowledge and performance together with confidence are integral factors in the development of a practitioner's overall competency and a drop in any of these could potentially have an adverse effect on a learner's self-efficacy (Leigh and Hurst, 2008; Lundberg, 2008; Perry, 2011). The

results in P3, inferred that this was not the case for the participants in the comparison group. At a time when their knowledge and performance dropped, their self-efficacy rose. Although the drop in both the knowledge and performance was not statistically significant, participants in the comparison arm appeared to be exhibiting an over confidence or self-efficacy in their abilities. As Andreatta and Lori (2014, p. 32) identified, students progressing along the confidence continuum towards the intermediate level, may become quite confident in their abilities, but they warned that this may be because they do not know what they don't know, leading to greater reported levels of confidence by learners than what was actually observed (Barsuk et al., 2015; Yuan et al., 2012). This gap was most pronounced at the intermediate level, where learners had acquired some skills, but had not developed the ability to accurately self-assess (Andreatta and Lori, 2014, p. 39). This offered a plausible explanation as there appeared to be a discrepancy in the comparison arms' self-efficacy reports and their actual observed performance.

Gonzalez and Sole (2014) in a study on the development of clinical skills, found that participants demonstrated limited self-awareness in relation to their technical skills, despite high levels of self-reported confidence. Davis et al. (2006 ) in their systematic review found that this was true across a range of professional groups with the least skilled practitioners being the most self-confident. As a result, they advised that this type of data should be used with great caution. This was certainly true for my study and the results further substantiate the warning by Davis et al. (2006 ). As Barsuk et al. (2015) and Yuan et al. (2012) opined, confidence levels cannot predict or be a proxy of actual performance, especially as this could adversely impact on patient safety (Andreatta and Lori, 2014, p. 33; Yang and Thompson, 2010; Yang et al., 2012, ).

Although effective feedback during the debriefing process enhances confidence (Spruit et al., 2014) the lower confidence/self-efficacy of the intervention group could be related to their increased self-awareness and ability to self-assess that the additional opportunity to reflect on their performance afforded. As Andreatta and Lori (2014, p. 39) suggest, SBE educators could assist in increasing a learner's self-awareness through the provision of specific feedback about their performance, which would also assist them in developing more accurate self-assessment skills. Lestander et al. (2016) found that increasing the opportunities for students to reflect, promoted an increased self-awareness and enabled them to develop a better understanding of both nursing and patient safety issues. This increased self-awareness was also found by Merriman et al. (2014) in their randomized controlled trial evaluating the effectiveness of SBE compared to classroom teaching for student nurses. Once again this discussion, although mainly theoretical in nature, should be of great interest to SBE educators and researchers as the participant's skills in self-assessment and their actual self-awareness could potentially impact on the efficacy of SBE as a learning and teaching methodology. Thus, in terms of research and development, a number of potential areas for future investigation are highlighted.

#### **6.3.4 - Self-efficacy discussion summary**

Overall, there was insufficient evidence to support the notion that a learner's self-efficacy/confidence was enhanced through either the Sim-TDP model or the traditional SBE approach. There were no statistically significant differences in the mean scores between the groups, which led to the rejection of the hypothesis  $H_{2.2}$  and the rejection of  $H_{1.2}$  in P1 and P2. This led to the acceptance of the relevant null hypothesis. This was reversed in P3 where a statistically significant difference was found in the mean scores in favour of the comparison group, which led to the acceptance of the

hypothesis H<sub>1.2</sub>. Alarming, this occurred at a time when the participant's knowledge and performance scores dropped post-intervention, which led me to reason that this was due to a lack of self-awareness skills and, the subsequent development of an overconfidence in their abilities.

A clear dissonance was evident in the literature related to confidence and self-efficacy, which may have been the result of the variation in the educational contexts evaluated, together with the wide differences in the research methods used (Cant and Cooper, 2010; Kardong-Edgren et al., 2010; Weaver, 2011a; Yuan et al., 2012). My study adds to the debate. As an SBE research output, the use of confidence/self-efficacy ratings has been described as a low level metric (Adamson, 2015) equivalent to the first level of reaction in Kirkpatrick's levels of evaluation in training programmes (Kirkpatrick and Kirkpatrick, 2005, p. 27). As Adamson (2015) argued, these cannot be depended upon as adequate evidence for the effectiveness of SBE. In exploring the effects of Sim-TDP this section uncovered a number of potential factors that could affect a learner's confidence/self-efficacy. Although my study only adds to the dissonance in the SBE literature in this area the subsequent discussion, although speculative in nature, should nevertheless be of great interest to SBE educators and researchers as it could potentially impact on the efficacy of SBE as a learning and teaching methodology. Again not only in relation to SBE but also in the broader healthcare education arena. Thus this section of the chapter offers a number of potential areas to guide future healthcare educational research.

## **6.4 – Knowledge discussion**

Over the three phases, the knowledge of the individuals was assessed using the knowledge questionnaire and analysed at an individual level using a number of statistical tests. The results from the analysis raised a number of interesting points to explore in relation to the use of Sim-TDP and its impact on the knowledge of learners.

#### **6.4.1 – Knowledge and simulation with team deliberate practice**

The *t*-tests and Mann-Whitney *U* tests performed across all phases on knowledge scores found that there was no statistically significant difference in the scores. The multiple regression analysis also did not identify any statistically significant predictors. Therefore, I rejected the hypothesis  $H_{1.3}$  and accepted the null hypothesis  $H_{01.3}$ . However, there did appear to be a progressive rise overtime in the scores of both arms, but the mixed ANOVA analysis found no statistically significant difference between the knowledge scores. Therefore, the hypothesis  $H_{2.3}$  was rejected and, the null hypothesis  $H_{02.3}$  accepted. These results were in line with the findings from a number of nursing SBE studies (Everett-Thomas et al., 2016; Hayden et al., 2014b), a systematic review by Jansson et al. (2013) and a meta-analysis by Hegland et al. (2017) that found that SBE did not demonstrate any statistically significant improvement in the knowledge of participants. This was also found when SBE was compared to other instructional designs (Bowling and Underwood, 2016; Jeffries and Rizzolo, 2006; Kardong-Edgren et al., 2007; Kardong-Edgren et al., 2015; Konicki and Miller, 2016; Rutherford-Hemming et al., 2016).

This lack of any statistically significant difference in the scores was, however, in direct contrast to other SBE studies in nurse education where statistically significant increases had been reported (Aqel et al., 2014; Burns et al., 2010; Gates et al., 2012;



Kardong-Edgren et al., 2009; Luctkar-Flude et al., 2015; Madden, 2006; O'Leary et al., 2016; Shinnick, Woo, and Evangelista, 2012; Shinnick et al., 2015). In the broader healthcare literature, a meta-analysis of 118 SBE studies (8595 participants) by Cook et al. (2011a) found a large statistically significant pooled effect size related to knowledge gains of 1.20 (95% CI, 1.04-1.35;  $p < 0.001$ ). They concluded that SBE interventions led to a large gain in knowledge. In another meta-analysis of forty-two studies (2607 participants) that compared SBE to other teaching methodologies, Cook et al. (2012) found a small but statistically significant pooled effect size of 0.30 (95% CI, 0.16-0.43;  $p < 0.001$ ) that was in favour of SBE developing participants' knowledge.

This dissonance in the SBE literature was recognised in the nursing literature by Cant and Cooper (2010) in their systematic review. They found that of the nine studies analysed, using knowledge as an outcome measure, only four reported any statistically significant improvements in the scores of participants. Laschinger et al. (2008a) also reported mixed results in the effects that SBE had on the knowledge of participants in their systematic review. They also noted that in the studies where gains were reported that this was often short lived and a decay in knowledge then ensued. Although they did not attribute this to either learning or decay curves (Chatham, 2009, pp. 27-60; Jaber and Bonney, 1996; Lammers et al., 2008; Pusic et al., 2012) it did appear to follow this pattern. It was noteworthy that, although not statistically significant, the results in my study suggested that participants in both the intervention and comparison arms had gradual gains in their knowledge scores, which was reflected in their parallel trajectories, with both reaching a similar inflection point where their rate of learning slowed down (Lammers et al., 2008; Pusic et al., 2011). Overall, the nature of the results I feel only add to the dissonance in the SBE literature generally around knowledge. Nevertheless this should not dissuade SBE educators and researchers from investigating this further so that a clear picture into the cause and effect of SBE on

a learner's knowledge can be ascertained. The study and discussion, although speculative, offer a number of potential areas that could direct future SBE research and development.

#### **6.4.2 - Knowledge and cognitive load**

Although not statistically significant, it was notable that, with the exception of the P1 pre-intervention knowledge scores, the comparison arms scores remained marginally higher than the scores of the intervention arms. This raised the possibility that the intervention had a higher cognitive load than the traditional SBE, thus overloading the participants' working memory and reducing their learning (Leppink and van den Heuvel, 2015; van Merriënboer and Sweller, 2010; van Merriënboer and Sweller, 2005). The addition of the "walk through" and the opportunity to repeat the scenario may have added to this load. Certainly the drop in performance and knowledge scores in P3 was intriguing and suggested that the scenarios were potentially too difficult for the participants' current educational level, leading to increased cognitive load (Leppink and van den Heuvel, 2015; van Merriënboer and Sweller, 2010; van Merriënboer and Sweller, 2005). A research study that explored the interaction between SBE and cognitive load and, how this relates to the transfer of theoretical knowledge into a clinical situation, would be justified. This discussion, although academic in nature, should be of great interest to SBE educators and researchers as this could potentially impact on the efficacy of SBE as a learning and teaching methodology. As this area is relatively new to the SBE arena it has not been investigated in any this offers a number of potential areas for future SBE research and development.

### **6.4.3 – The role of SBE in the cognitive domain**

When I explored the systematic reviews and meta-analyses there appeared to be a variation in what SBE method was chosen and what learner groups had been targeted. The reviews by Jansson et al. (2013) and Hegland et al. (2017) only focused on the use of high fidelity SBE in qualified nurses and, the review by Cant and Cooper (2010) focused on the use of two particular SBE methods, that of medium and high fidelity manikin-based SBE in both undergraduate and qualified nurse education. The review by Laschinger et al. (2008a) focused on all SBE methods across a range of pre-licensure and undergraduate healthcare professions. Similarly, the meta analyses by Cook et al. (2011a) and Cook et al. (2012) were more inclusive covering all SBE methods and all healthcare professions, including undergraduate and post-graduate learners. This variation in approaches made comparisons between the reviews difficult. This was compounded by the large inconsistencies between the studies that each of the reviews included, a point that the authors acknowledged. In particular, both Cook et al. (2011a) and Cook et al. (2012) reported that many of the studies failed to fully describe key features and, as a result, limited the inferences they could make. They concluded by calling for further robust SBE versus SBE studies to explore the effect of SBE design features on optimising participant learning.

As Cook and Triola (2009) stated, the benefits of SBE vary for different educational objectives, therefore, deliberate alignment of various methods was essential to enhance learning. A process, in terms of SBE versus SBE studies, that could be difficult to achieve as post-test studies using between two group comparisons, similar to my study, demonstrate smaller but statistically significant effect sizes when compared to the other studies (Cook et al., 2011a). Thus making justification more difficult. Studies that adopted similar aims, participant populations and method of

delivery to my study reported mixed results, with a number of studies finding no improvement in the knowledge of participants (Hayden et al., 2014b; Jeffries and Rizzolo, 2006; Kardong-Edgren et al., 2007; Kardong-Edgren et al., 2015), particularly around physiological knowledge (Everett-Thomas et al., 2016), whilst others found statistically significant improvements (Aqel and Ahmad, 2014; Burns et al., 2010; Gates et al., 2012; Kardong-Edgren et al., 2009; Luctkar-Flude et al., 2015; Shinnick et al., 2012; Shinnick and Woo, 2015). The effect of SBE on knowledge gains, whether it was compared to other education methods or against other SBE initiatives, remained inconclusive, and my study did not bring any greater understanding to this area. Rather, it added to the dissonance.

Bender et al. (2014) following their study cautioned against relying on cognitive measures to project clinical performance because they found a weak correlation between knowledge scores and the actual performance of their participants. My study adds credence to this statement, which Cook et al. (2012) further substantiate, in their meta-analysis, when they found that pooled effect sizes varied depending on what outcome that was being measured. The smallest effect sizes were found for those outcomes that were knowledge-based and these increased for outcomes that were focused on skills or behaviours. This was evident within my study as the knowledge-based outcomes were not statistically significant, whilst the increase in performance over time in the intervention group was statistically significant. Cook et al. (2012) concluded that their findings indicated that the benefit of SBE was greater for the higher-order outcomes, such as the measurement of behaviours.

Anderson et al. (2008) made a very salient point regarding the use of SBE when they noted that, as it was student centred and based on experiential learning approaches, it should be viewed as a process. A process, (Jeffries and Rizzolo, 2006) and Kardong-Edgren et al. (2010) reasoned, should be directed towards the synthesis and application of knowledge and, therefore, should be designed to give learners the opportunity to apply their knowledge in a realistic setting, rather than towards the development of new knowledge. Setting knowledge at the level of application has been recommended in a number of SBE standards (Lioce et al., 2015; Lioce et al., 2013; Sando et al., 2013) and, links to Bloom's taxonomy (Anderson et al., 2001; Bloom, 1956). This level enables learners to use theory to understand practice and transfer their classroom knowledge into practice (Hope et al., 2011; Pollock and Biles, 2016; Prowse, 1996). Viewing learning in SBE as a process, as recommended by Anderson et al. (2008), set at the level of application appeared to be congruent with a number of theoretical models that underpinned my SBE curricula strategy. This included the four stage assessment model developed by Miller (1990) in which the first two stages were knowledge based, which had to be achieved before moving on to the latter two performance based stages (Miller, 1990). As Alinier (2007) asserted, possessing the relevant theoretical knowledge required for a scenario was an essential pre-requisite for effective SBE. It was the divide between these stages that Alinier (2007) stressed as the boundary between theory and practice. Once again, this would enable learners to transfer knowledge from the classroom into their clinical practice (Bland and Tobbell, 2016; Hope et al., 2011; Pollock and Biles, 2016). Once again this discussion, although theoretical in nature, should be of great interest to SBE researchers especially around the use of knowledge measures as a proxy to the efficacy of SBE as a learning and teaching methodology. Nevertheless, researchers should not be dissuaded from investigating this area of SBE practice so that a definitive cause and effect could be

established. This study and discussion offer a number of potential areas for future SBE research and development.

#### **6.4.4 - Knowledge discussion summary**

In summary, the Sim-TDP intervention had no statistically significant effects on the knowledge scores of participants, although there did appear to be a progressive rise over time in the scores. This led me to reason that SBE, in terms of knowledge, should be aimed at providing learners with the opportunity to apply their existing knowledge in a realistic scenario to optimise the transfer of knowledge into the clinical setting. It should not focus on the generation of new knowledge. Future SBE research should be focused on identifying the optimal instructional designs that would enable educators to achieve this.

Although not statistically significant, another interesting finding was that the comparison arms scores overall remained marginally higher than the scores of the intervention arms. This raised the possibility that the intervention had a higher cognitive load than the traditional SBE, thus overloading the participants' working memory and reducing their learning. The subsequent exploration of this led me to agree with Cook et al. (2011a) who called for a shift away from studies that compared SBE to other learning and teaching methodologies to more robust SBE versus SBE studies aimed at exploring the effect of SBE design features that enhanced learning. This could be facilitated by further research into the cognitive domain of learning that focused on the application of knowledge into practice and what method of SBE aligns to the relevant levels in Bloom's (1956) taxonomy. In addition, research should be undertaken into the

use of SBE in conjunction with a range of other educational methods, so that its role and, optimum use, could be ascertained within a blended approach (Anderson et al., 2014; Department of Health, 2011; Nursing and Midwifery Council, 2010). In exploring the effects of Sim-TDP this section uncovered a number of potential factors that could affect a learner's knowledge gain. Although my study only adds to the dissonance in the SBE literature in this area, the subsequent discussion, although speculative in nature, should nevertheless be of great interest to SBE researchers especially around the use of knowledge measures as a proxy to the efficacy of SBE as a learning and teaching methodology. Thus this section of the chapter offers a number of potential areas to guide future healthcare educational research.

## **6.5 - Implications and recommendations for SBE practice**

The findings of my study have a number of implications for the delivery of SBE and, as a result, a number of recommendations for educational practice and, future pedagogical research, will be explored.

### **6.5.1 - Recommendations for SBE educational practice**

In exploring the effects of Sim-TDP the study and discussion uncovered a number of potential factors that could affect a learner's performance, confidence/self-efficacy and knowledge gain. These should be of great interest to SBE educators as they could potentially impact on the efficacy of SBE as a learning and teaching methodology. An

interest that would also extend to the broader healthcare education arena. The results inferred that the Sim-TDP intervention was a viable instructional design to deliver effective SBE in an undergraduate nursing curriculum. As the study was undertaken in an existing curricula, as opposed to many other SBE studies, which have tended to occur in more “laboratory type” conditions, give greater credence to the inferences made. The Sim-TDP intervention offered a number of potential benefits over the traditional SBE approach (Appendix 13). The statistically significant improvement in the performance of the intervention arm over time meant that I could accept hypothesis  $H_{2.1}$ , which inferred that Sim-TDP was more effective than the traditional SBE approach meeting one of the key goals of DP that of achieving continuous skill improvement (Bond et al 2008, McGaghie 2008, McGaghie et al 2010, and Motola et al 2013). Adopting the Sim-TDP model educationally, would enable SBE educators to enhance the learning of students through the provision of structured opportunities to both rehearse their skills and receive feedback on their progress. One potential finding was that the results inferred that the Sim-TDP intervention accelerated the learning curves of the participants and, although this was short lived, provided the initial “loading dose” of SBE that optimised performance. Therefore, I would recommend that SBE educators adopt this model since it brought a number of other benefits for educational practice.

One such benefit was that it followed the classic three stage approach to SBE that of the pre-brief, scenario and debrief, and, as a result, it would be easily incorporated into existing SBE deliveries. The results also alluded to the increased self-awareness of participants that Sim-TDP could develop, particularly through the increased opportunity to reflect on practice avoiding over-confidence (Andreatta and Lori, 2014, p. 39; Lestander et al., 2016). A vital component in the development of safe effective practice (Andreatta and Lori, 2014, p. 33; Yang and Thompson, 2010; Yang et al., 2012, ). Sim-



TDP also offered a potential solution to the resource limits that SBE educators frequently face when delivering SBE. As it was delivered in the same timeframe as the traditional SBE with the same staffing resource it provided a more resource efficient instructional design that, not only potentially optimised participant learning, but maximised the use of resources. The results also supported the use of small teams in the Sim-TDP intervention and, once from an educator's perspective, positively impacts on SBE resourcing, whilst enhancing the taskwork and teamwork skills integral to high quality team training. As professional nursing regulators and educational institutes explore replacing clinical practice with simulation this potentially would be of interest to simulation based educators in nursing. The reduced time on task was also very encouraging and, in terms of patient safety, could have extremely beneficial effects on patient care with participants being able to recognise deterioration earlier. A significant factor in the delivery of safe effective healthcare (The National Confidential Enquiry into Patient Outcome and Death, 2005; The National Institute for Health and Clinical Excellence, 2007; The National Patient Safety Agency, 2007).

In the process of the analysis, a number of incidental effects were found that related to the instructional design features of the Sim-TDP intervention and SBE generally. The initial acceleration of the participant's learning curve that followed the Sim-TDP "loading dose" was a very encouraging but, of some concern, was the fact that a rapid decay in the participant's skills followed. This had been well reported in the SBE literature with many studies focusing on the optimum timing and gap between SBE sessions. No definitive approach was identified but, the use of spaced education (Carpenter et al., 2012; Kerfoot et al., 2007) or distributed practice (Cepeda et al., 2009) offered a potential solution. To avoid the decay, educators should review the delivery of their programmes and use repeated doses, or "maintenance doses" (Carpenter et al., 2012)

with an optimal spacing gap of between 10–20 % before the next SBE scenario. This area has the potential to have a significant impact on the development and delivery of SBE and should be considered alongside achieving the optimal challenge point for learners (Guadagnoli et al., 2012). As the results inferred, poorly designed scenarios could push learners over their challenge point and lead to decreased performance. Key to avoiding this would be to set the scenario learning objectives at the correct level for the learner's experience and sequence the order of the scenarios so that their representative design features were also set at the appropriate level. This would optimise cognitive load by setting an appropriate level of both intrinsic and extraneous load.

In terms of self-efficacy, the Sim-TDP model had a very mixed affect. With the exception of a statistically significant increase in the self-efficacy of the comparison group in P3, all other tests across the phases were statistically insignificant. Overall, there was insufficient evidence to support the notion that a learner's self-efficacy/confidence was enhanced through either Sim-TDP or traditional SBE. A very interesting area highlighted was the potential development of over-confidence in the participants in the comparison group. SBE educators need to be cognisant of this and the impact that the safe learning environment provided by SBE has on learners. As Barsuk et al. (2015) and Yuan et al. (2012) advised, the self-efficacy/confidence levels of learners cannot predict or be a proxy of actual performance, especially in light of the potential impact this could have on the safety of patients (Andreatta and Lori, 2014, p. 33; Yang and Thompson, 2010; Yang et al., 2012, ).

In terms of knowledge, there was no statistically significant effects over the course of the study and this was reflected in the near parallel trajectories of the learning curves. Both reached a similar inflection point where the rate of learning slowed (Lammers et al., 2008; Pusic et al., 2011). Nevertheless, when the results were explored, I found a very pertinent factor related to learning in the cognitive domain. It was evident in the literature that there was a great deal of dissonance surrounding the impact of SBE on the knowledge of learners, in fact, Bender et al. (2014) cautioned against using cognitive measures to project clinical performance. They stressed that knowledge outcomes had a weak correlation with performance outcomes. Having reviewed this in light of my results, I would advise that SBE educators view SBE as an educational process directed towards the synthesis and application of theoretical knowledge and not the generation of new knowledge (Anderson et al., 2008; Jeffries and Rizzolo, 2006; Kardong-Edgren et al., 2010).

### **6.5.2 - Recommendations for pedagogical research**

Once again in exploring the effects of Sim-TDP the study and discussion uncovered a number of potential factors that could affect a learner's performance, confidence/self-efficacy and knowledge gain. These should be of great interest to SBE researchers as they could potentially impact on the efficacy of SBE as a learning and teaching methodology. Thus this section of the chapter offers a number of potential areas to guide future SBE healthcare educational research, areas that may also be of interest to colleagues studying broader healthcare educational methodologies. Overall, the results supported the introduction of Sim-TDP as an innovative learning and teaching methodology and, therefore, achieved a balance between maximising the delivery of

SBE and optimising participant performance. The discussion of these highlighted a clear need for further research in this field (Appendix 14). Future research studies are required to validate the effects of Sim-TDP on performance that I replicate my study but undertaken with larger cohort sizes. In addition, studies are required to ascertain the effects of the model on different professional groups and, in a range of educational settings, so that the efficacy of this approach and, its use as a “loading dose”, can be established in a wider context. The incidental findings related to the representative design features, cognitive load, and the preservation of performance levels through the use of a “maintenance dose” should also be investigated, particularly the use of spaced or distributed practice. These should focus on identifying the most appropriate SBE design features to use at different educational stages (Yuan et al., 2012) and, through robust SBE versus SBE studies, identify the features that enhance learning (Cook et al., 2011a). As the results also supported the inclusion of teams in the Sim-TDP intervention, future research should investigate how the intervention effects shared or team DP in terms of assessment, cognitive load, communication skills, situational awareness and overall the impact on the quality of teamwork.

In terms of self-efficacy, the intervention had a very mixed affect. With the exception of a statistically significant increase in the self-efficacy in the comparison group in P3, all other tests across the phases were statistically insignificant. This mirrored the dissonance in the SBE literature, with my study only adding to the debate. Overall, there was insufficient evidence to support the notion that a learner’s self-efficacy/confidence was enhanced through either the intervention of Sim-TDP or the traditional SBE. Nevertheless, the fact that the participants began to seek out additional learning opportunities suggested an increase in motivation (Chee, 2014). As a central component to DP theory (Ericsson et al., 1993; Ericsson et al., 2009; Ericsson and

Neil, 1994) this, once again, warrants further investigation. Future research studies should also be undertaken, with larger cohorts in a range of educational settings, focusing on the effect of Sim-TDP on the motivation of learners. A very interesting area highlighted was the potential development of over-confidence in the participants in the comparison group. As the participants progressed along the confidence continuum towards an intermediate level, they potentially became more confident, but as their performance scores were lower, this raised the question over their ability to accurately self-assess, which potentially led to a state of over-confidence (Andreatta and Lori, 2014, p. 32; Davis et al., 2006 ). As reflection has been highlighted as a method of increasing self-awareness (Andreatta and Lori, 2014, p. 39; Lestander et al., 2016) the Sim-TDP intervention, with its additional opportunities to reflect, offers a viable model to increase self-awareness. Further research studies would be needed to assess the impact of Sim-TDP on self-awareness and explore the potential development of overconfidence in learners especially, the impact of the safe learning environment that SBE provides. Other areas for future research include: the impact of cognitive load on self-efficacy/confidence especially, as overload can have a negative impact on learning; the effects of various spacing models, as the longer gap between scenarios appears to have an adverse effect self-efficacy; and, the identification of appropriate SBE scenarios to enhance the self-efficacy of participants as they progress along the confidence continuum (Andreatta and Lori, 2014, p. 32).

The findings also raised questions over the use of participant self-efficacy ratings and, as Barsuk et al. (2015) and Yuan et al. (2012) have cautioned, they cannot predict or be a proxy to actual performance, especially with the potential impact this could have on patient safety (Andreatta and Lori, 2014, p. 33; Yang and Thompson, 2010; Yang et al., 2012, ). Consequently, SBE researchers have been advised that they cannot be

depended upon as evidence of the effectiveness of SBE and, as a result, they should be used with great caution (Adamson, 2015; Davis et al., 2006 ). However, as self-efficacy/confidence has been described as an integral factor in the development of a practitioner's competency and a drop in these could potentially have an adverse effect on competency and overall capability (Leigh and Hurst, 2008; Lundberg, 2008; Perry, 2011). Therefore, it is imperative that SBE educators undertake further research into the validity and reliability of self-efficacy/confidence outputs.

A similar debate was evident in the literature surrounding the use of participants' knowledge scores. As an output, Bender et al. (2014) cautioned against using cognitive measures as a method to project clinical performance, arguing that there was a weak correlation between knowledge outcomes and performance outcomes, a point echoed in my study. The results supported the opinion that SBE educators should view SBE as an educational process, directed towards the synthesis and application of theoretical knowledge, rather than the generation of new knowledge (Anderson et al., 2008; Jeffries and Rizzolo, 2006; Kardong-Edgren et al., 2010). Therefore, future SBE research should focus on developing optimal instructional designs, including Sim-TDP, that enable educators to achieve the transfer of existing knowledge into the clinical setting. Included in this research should be an exploration of how SBE could be used optimally, within a blended learning and teaching approach, to ensure its effective use within a range of educational methods and not just as a stand-alone entity (Anderson et al., 2014; Department of Health, 2011; Nursing and Midwifery Council, 2010).

### **6.5.3 – Summary of recommendations**

Overall, the results supported the introduction of Sim-TDP as an innovative learning and teaching approach that potentially achieved a balance between optimising participant's performance whilst maximising resources. Sim-TDP could be easily incorporated into existing SBE deliveries and, educationally, it enabled SBE educators to enhance the learning of participants through the provision of structured opportunities to rehearse skills and receive feedback on progress. It also provided an opportunity to rehearse and further develop their skills in a team setting. This ensured that they could contribute effectively to their team's performance and continue to develop their team working skills.

In terms of participants' learning curves, Sim-TDP offered, as Weinger (2010) recommended, a "loading dose" of SBE that accelerated the learning curves of participants and decreased their time on task thus, enhancing their performance. However, a rapid decay in the participant's performance followed and I advocated, as recommended by Carpenter et al. (2012), that another SBE session should be integrated into a programme between 10–20% of the overall gap between the initial sessions. I also recommended that careful consideration should be given to the actual instructional design features of the scenario, such as the patient case and its representative design features, in order to reach an optimum challenge point (Guadagnoli et al., 2012) and avoid cognitive overload (van Merriënboer and Sweller, 2010; van Merriënboer and Sweller, 2005). The results inferred that poorly designed scenarios pushed learners over their challenge point leading to decreased performance. As Cook et al. (2012) stated, it was more about good instructional design than about the actual SBE itself. Critical to avoiding overload would be the development of scenarios that augmented cognitive load by optimising intrinsic load and decreasing extraneous load. This could be achieved by balancing the cues in the

scenario and the drive for increased realism and fidelity. More research studies are needed to identify the appropriate SBE approach to use at different educational stages (Yuan et al., 2012), including more robust SBE versus SBE studies that are aimed at exploring the effect of SBE design features that enhance learning (Cook et al., 2011a).

In terms of self-efficacy, the intervention had a very mixed effect statistically and, overall, there was insufficient evidence to support the notion that a learner's self-efficacy/confidence was enhanced through either the intervention of Sim-TDP or the traditional SBE experience. An area of concern was the potential for SBE to lead to an over-confidence in the learners. In terms of knowledge, there was no statistically significant effect, which was reflected in near parallel trajectories in the learning curves of both arms. There was insufficient evidence to support the use of Sim-TDP or, traditional SBE, to enhance knowledge acquisition. Rather, I would recommend that SBE educators should view SBE as a process directed towards the synthesis and application of theoretical knowledge and not the generation of new knowledge (Anderson et al., 2008; Jeffries and Rizzolo, 2006; Kardong-Edgren et al., 2010). Future SBE research should focus on developing optimal instructional designs, including the Sim-TDP initiative, that enable educators to achieve the transfer of knowledge into the clinical setting. These should include research into the role of and optimum use of SBE in a blended approach and not just as a stand-alone method (Anderson et al., 2014; Department of Health, 2011; Nursing and Midwifery Council, 2010).

## **6.6 - Chapter summary**



This chapter explored the impact of the Sim-TDP intervention in relation to the participant's performance, self-efficacy and knowledge. In the context of the SBE and educational literature, the results were critically analysed. Overall, the results supported the introduction of Sim-TDP as an innovative learning and teaching approach. This was true for the performance of participants, but in terms of the self-efficacy and knowledge, there was insufficient evidence to support the use of Sim-TDP. The results also raised a number of issues around the delivery of SBE and how this could affect participant learning. To optimise performance a number of recommendations related to the instructional design features of SBE were made. In exploring the effects of Sim-TDP the study and discussion uncovered a number of potential factors that could affect a learner's performance, confidence/self-efficacy and knowledge gain. These should be of great interest to both SBE educators and researchers as they could potentially impact on the efficacy of SBE as a learning and teaching methodology. An interest that would also extend to the broader healthcare education arena.

# Chapter 7 – Conclusion

## 7.1 – Chapter overview

This chapter concludes the thesis by summarising the key findings, limitations, unique contribution and provides recommendations for future SBE practice. SBE has been defined by Huang et al. (2008, p. 191) as “...a technique that uses a situation or environment created to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions and behaviours”. Its use as a learning and teaching methodology in nursing curricula has increased significantly during the past two decades (Bland and Tobbell, 2016; Harder, 2009; Jeffries and Spunt, 2008). This has been driven by concerns related to patient safety, including the competence of healthcare practitioners, the effectiveness of teams and the systems that they work in (Chief Medical Officer, 2008; Department of Health, 2008; Oermann, 2011; Wilford and Doyle, 2006). However, the introduction of SBE has not been without its challenges and, following a review of SBE within the UK, Anderson et al. (2014) identified that there was a clear need to develop the quality of SBE recommending that it should be integrated into all healthcare curricula using robust, quality assured educational approaches that were underpinned by high quality pedagogic research. This should include robust SBE versus SBE studies aimed at exploring the SBE design features that enhance learning (Cook et al., 2011a; Yuan et al., 2012).

As I was passionate about using SBE, I wanted to undertake an SBE versus SBE research study that would identify an approach that would optimise the learning of adult nursing students whilst maximising the use of the resources available. When I reviewed the relevant SBE and educational literature, I identified DP as a possible method to achieve this. This led to the development of the Sim-TDP model. The research study, therefore, focused on exploring the effects of this model compared to that of the traditional SBE on adult nursing students.

## 7.2 - Revisiting the studies aims

The overall aim of the research was to investigate the effect of Sim-TDP, compared to a traditional SBE approach, within a structured SBE strategy, on the performance, knowledge, and self-efficacy of second year adult nursing students. In keeping with the quantitative paradigm a number of hypotheses were developed:

- 1)  $H_1$  - Following the introduction of Sim-TDP the adult nursing programme students in the intervention group would have significantly different mean scores in the post-test than the comparison group in respect to their:
  - a. Performance ( $H_{1.1}$ )
  - b. Confidence/self-efficacy ( $H_{1.2}$ )
  - c. Knowledge ( $H_{1.3}$ )

$H_{01}$  - The null hypothesis being that following the introduction of Sim-TDP there would be no difference post-test between the adult nursing programme students in the intervention and comparison groups in relation to their:

- d. Performance ( $H_{01.1}$ )

- e. Confidence/self-efficacy ( $H_{01.2}$ )
- f. Knowledge ( $H_{01.3}$ )

2)  $H_2$  - The mean scores of the adult nursing programme students, following each phase of the research study, would differ significantly to those in the intervention group with respect to their:

- a. Performance ( $H_{2.1}$ )
- b. Confidence/self-efficacy ( $H_{2.2}$ )
- c. Knowledge ( $H_{2.3}$ )

$H_{02}$  - The null hypothesis being that the scores of the adult nursing programme students' would not differ significantly following each phase of the research study in respect to their:

- a. Performance ( $H_{02.1}$ )
- b. Confidence/self-efficacy ( $H_{02.2}$ )
- c. Knowledge ( $H_{02.3}$ )

3)  $H_3$  - Following the introduction of Sim-TDP the time on task of the adult nursing students in the intervention group would be significantly different from the times of the comparison group.

$H_{03}$  - The null hypothesis being that following the introduction of Sim-TDP there will be no difference between the time on task of the adult nursing students in the intervention and the times of the comparison group.

## 7.3 – Summary of findings

The analysis of the data led to a number of findings related to the hypothesise and the effects of the Sim-TDP intervention, which were discussed in chapter six but are summarised below:

1. Overall Sim-TDP optimised the performance of the participants. The results were:
  - a. The mixed ANOVA found a statistically significant difference in the mean scores overtime and, as a result, the hypothesis  $H_{2.1}$  was accepted and the null hypothesis  $H_{02.1}$  rejected. Thus inferring that:
    - i. Sim-TDP achieved a key objective of DP, which was the development of skills overtime.
    - ii. Sim-TDP supported the use of small teams in SBE and the concept of shared or TDP.
  - b. Sim-TDP did not have a statistically significant effect on the performance of the participants performance during P1, P2 and P3, and, as a result, the hypothesis  $H_{1.1}$  was rejected and the null hypothesis  $H_{01.1}$  accepted.
  - c. Sim-TDP had a statistically significant effect on the time on task in P1 and, as a result, the hypothesis  $H_3$  for this phase was accepted and the null hypothesis  $H_{03}$  was rejected.
    - i. Thus inferring that the intervention arm were quicker in achieving the scenario learning outcomes.

- d. Sim-TDP did not have a statistically significant effect on the time on task in either P2 or P3 and, as a result, the hypothesis  $H_3$  for these phases was rejected and the null hypothesis  $H_{03}$  was accepted.
2. Overall, there was insufficient evidence to support the notion that a learner's self-efficacy/confidence was enhanced through Sim-TDP. The results were:
  - a. In P1 and P2, no statistically significant findings were found, which led to the rejection of the hypothesis  $H_{2.2}$  and the rejection of  $H_{1.2}$ . This led to the acceptance of the relevant null hypothesis.
  - b. In P3, a statistically significant difference was found in the mean scores in favour of the comparison group, which led to the acceptance of the hypothesis  $H_{1.2}$  for this phase.
    - i. This occurred at a time when their knowledge and performance scores dropped post-intervention
3. The Sim-TDP intervention had no statistically significant effects on the knowledge scores of the participants leading to the rejection of the hypothesis  $H_{1.3}$  and  $H_{2.3}$ , and the acceptance of the null hypothesis  $H_{01.3}$  and  $H_{02.3}$ .

## 7.4 - Distinctiveness of the study

Once again in exploring the effects of Sim-TDP the study and discussion uncovered a number of potential factors that could affect a learner's performance, confidence/self-efficacy and knowledge gain. These should be of great interest to SBE educators and researchers as they could potentially impact on the efficacy of SBE as a learning and

teaching methodology. There were a number of distinct features to my study. Firstly, the main focus was the design, implementation and analysis of a new innovative model for SBE delivery, Sim-TDP. This model combined best practice standards for the delivery of SBE (INACSL Standards Committee, 2016d; The International Nursing Association for Clinical Simulation and Learning, 2013) with the DP framework (Ericsson 2004). This offered participants the opportunity to work towards well-defined goals, rehearse their skills in a highly structured model that empowered them to review and reflect on their performance under expert guidance and feedback (Appendix 13). In doing so, it potentially accelerated the learning curves of the participants, enabling them to achieve greater performance levels during the same time period that traditional SBE took. It also reduced the time on task of the participants when compared with more traditional approach to SBE. Thus, the Sim-TDP model potentially provides SBE educators with a framework for delivering SBE and, a “loading dose”, as the results point to its effectiveness and efficiency in optimising the performance of adult pre-registration nurses. As it followed the INACSL Standards of Best Practice: Simulation<sup>SM</sup> (2016d; The International Nursing Association for Clinical Simulation and Learning, 2013) the model itself could be easily integrated into existing SBE deliveries as either a standalone scenario or as part of an integrated SBE curricula programme.

Secondly, the results inferred that the use of small teams during SBE scenarios was an effective approach to developing the skills of participants. Uniquely, it introduced the concept of shared or team deliberate practice into a healthcare education setting. DP in healthcare and, in particular, nursing has tended to focus on individual skill development so my study has added considerably to this field. They supported the use of the Sim-TDP model, early in the career of undergraduate adult nursing students, in enhancing the quality of the taskwork and potentially the team working tracks of team

training as, overtime, the participants' performance, as a team, improved. Sim-TDP enabled the participants to engage in deliberate team training activities to practice their taskworking skills whilst potentially develop their team working skill of coordination. Therefore, it has moved the traditional view of individual practice into the realms of teamwork and highlighted the impact this has on optimising performance using teams. In doing so, it offers an approach that not only enhances performance but also maximises the resources needed for delivery. This was achieved using the same resources and timeframes as the traditional SBE approach. In essence, it potentially optimised performance whilst making SBE delivery more cost effective maximising the use of the resources available in terms of staff, curricula time, specialist facilities and equipment. Consequently, it achieved a balance between optimising performance and maximising resources. As professional nursing regulators and educational institutes explore replacing clinical practice with simulation this potentially would be of interest to simulation based educators in nursing.

In addition, the study adds to the body of team based healthcare literature and, in particular, its integration of this approach into an undergraduate curricula. As there was a dearth of healthcare literature on the application of TDP the study provided a template for the use of an event-based performance checklists to evaluate taskwork skills, including the use of a representative design approach. The results also supported the separation of the two main elements of team training, taskwork and team work, early in the careers of undergraduate adult nurses and as a result Sim-TDP offers a potentially viable approach to developing their overall teamworking skills. An approach that could be developed across a range of professional programmes. Thus adding to the SBE team training literature.



A third unique feature of the study was its design, a longitudinal quasi-experimental approach. There was a dearth of literature in the nursing literature regarding the use of DP and TDP in nurse education. What was available mainly focused on individual skill development and not the broader skills required by nurses to recognise deterioration in a patient. The study by Whyte and Cormier (2014) was one of the few exceptions, but this was a small-scale study that used volunteers as participants outside their nursing programme. Uniquely, my study followed over ninety adult pre-registration nursing students, over a period of one year, as they progressed through their nursing programme and undertook an integrated and structured SBE programme. As a result, the study took place in an existing curricula setting and, as the participants were not volunteers, ethically they could opt out of the study, this added to the distinctiveness of the study. The study also observed the participants actual performance with the data being collected and analysed using an SBE versus SBE study design that focused on comparing different methods of SBE delivery so that their effectiveness and efficiency could be explored. This was unique in terms of nursing, as many studies had compared SBE with other learning and teaching methods and not other SBE delivery approaches. As a result, my study adds considerably to the nurse educational literature, increases the professions understanding of SBE delivering using DP and TDP. The Sim-TDP model also has the potential to be utilised across all healthcare education.

Once again in exploring the effects of Sim-TDP the study and discussion uncovered a number of potential factors that could affect a learner's performance, confidence/self-efficacy and knowledge gain. These should be of great interest to SBE educators and researchers as they could potentially impact on the efficacy of SBE as a learning and teaching methodology. The study raised the question of the reliability of using a learners self-efficacy score as a measure of their actual performance, and in doing so

added to the weight of SBE literature expressing similar concerns. Alongside this, the use of knowledge based outcomes as a proxy to an individual's performance was also questioned and, in doing so, added further weight to the SBE literature asserting that SBE should focus on the application of existing knowledge and not the development of new knowledge. Overall, the study has added considerably to the body of SBE literature. Not only through the introduction of the Sim-TDP model but, it has also provided a greater understanding of the learning processes that take place during and individual SBE scenario, as well as over an extended SBE programme. Thus the study offers a number of potential areas to guide future SBE healthcare educational research, areas that may also be of interest to colleagues studying broader healthcare educational methodologies.

## **7.5 – Summary of recommendations**

The findings led to a number of recommendations for future educational SBE practice and research, which were discussed in chapter six but are summarised below.

### **7.5.1 – Summary of the recommendations for SBE educational practice**

Overall, the results supported the introduction of Sim-TDP as an innovative learning and teaching approach and the following recommendations for educational practice were made (Appendix 14).

1. The results inferred that the Sim-TDP intervention was a viable instructional design to deliver effective SBE in an undergraduate nursing curriculum and, as such, its implementation into existing nursing curricula should be considered.

Especially as it:

- a. Optimised performance:
  - i. Improved performance of participant's overtime.
  - ii. Potentially accelerated the learning curves of participants.
  - iii. Possibly acted as a "loading dose" of SBE.
  - iv. It reduced time on task leading to earlier recognition of a deterioration in a patient's condition.
- b. Could be easily incorporated into the existing SBE programmes/curricula.
- c. Provided additional opportunities to reflect that led to:
  - i. Potentially an increase in self-awareness
  - ii. Possibly avoided over-confidence
- d. Maximised resources:
  - i. Offered a potential solution to the resource limits that SBE educators face e.g.:
    1. Time
    2. Specialist facilities and equipment
    3. Staffing
  - ii. Offered an approach that could replace clinical practice with simulation

2. The results also supported the inclusion of small teams in the Sim-TDP intervention and, once again, this approach should be considered in nurse education. Especially as it:

- a. Enhanced the taskwork and coordination skills integral to high quality teamwork.
  - b. Had a potential positive benefit in the resourcing of SBE.
- 3. SBE delivery should be directed towards the synthesis and application of theoretical knowledge and not the generation of new knowledge.
- 4. Representative design features, set at the learner's current level, should be incorporated into SBE scenarios so that they are exposed to situations that represent the range and distribution of situations and cues in the healthcare environment. These should capture the performance of an individual in a consistent and reproducible manner.

### **7.5.2 – Summary of the recommendations for pedagogical research**

As an innovative learning and teaching approach, the development and implementation of Sim-TDP potentially led to a balance between maximising the delivery of SBE and optimising participant performance. The discussion in chapter six highlighted a clear need for further research in this field (Appendix 14), including:

- 1. Further SBE versus SBE research on the Sim-TDP model with larger learner populations, undertaken in a range of settings, so that the efficacy of this approach and its impact on the performance of learners, in a broader context, can be explored, such as:
  - a. Other higher education institutes
  - b. Simulation centres
  - c. Insitu SBE

2. The effects of Sim-TDP on other professional groups in a range of educational settings and undertaken with larger participant populations.
3. The use of the taskwork and team work components of team training in a range of educational settings and undertaken with larger participant populations. To ascertain:
  - a. The sequence of delivery for example taskwork before teamwork or together.
  - b. When they should be introduced into an undergraduate curricula
  - c. Effect during inter-professional SBE activities.
4. The use of Sim-TDP and its impact within a blended learning and teaching approach.
5. The impact of Sim-TDP on self-awareness of learners in a range of educational settings and undertaken with larger participant populations.
6. Further research into the validity and reliability of self-efficacy/confidence outputs.
7. An exploration of the potential development of overconfidence in learners undertaking SBE and the impact of the safe SBE learning environment.
8. The impact of Sim-TDP on the knowledge of learners in a range of educational settings and undertaken with larger participant populations.
9. Further SBE research on developing optimal instructional designs that enable learners to transfer their existing knowledge into the clinical setting.

## **.7.6 - Study limitations**

The study had several limitations. Firstly, I would acknowledge the potential of bias towards the use of SBE following many years of using this learning and teaching methodology. To minimise this, I adopted a transparent approach to the study and endeavoured to leave a clear decision making trail that would enable the reader to critically review all aspects of the study. The second limitation was the actual research design which, in an ideal world, I would have adopted a randomised control trial. However, in the context of an existing curricula setting this was not achievable. As a result, the quasi-experimental design adopted meant that there were limitations to the generalisability of the study findings, which only allowed me to make associative, not causal, inferences (Sawyer et al., 2011). Therefore the design could of had a significant impact on the results. In addition, as I was comparing Sim-TDP with the traditional SBE delivery the latter group only had one video recorded, which I had to use to compare with both the first and second recorded video of the intervention groups. Including a second video recording and, therefore, a second, opportunity of practice in the comparison groups would have meant that this arm was receiving a key component of DP and TDP and not the traditional SBE approach. This potentially could have led to a reduction in the distinctiveness of the two approaches and my inability to compare Sim-TDP to the traditional approach. However, I do acknowledge this as a limitation as by not including the second video this could potentially bias the results.

As I also used a convenience sampling technique this also limited the generalisability of the findings. However, to reduce threats to internal validity, I randomly assigned these naturally occurring groups into their respective arms. Additionally, the SBE scenarios were delivered on separate occasions and participants were asked not to discuss the scenarios so that any possible contamination of the results would be avoided. Despite this endeavour, the possibility of participants discussing the scenarios

with peers out with the study could not be fully controlled it, therefore, remained a potential threat to internal validity. The study sample size was relatively small ( $N = 93$ ) and, although the  $\alpha$ -level was set at 0.5 to reduce the probability of a type I error the  $\beta$ -level had to be reset at 0.7, which was below the recommended value of 0.8 (Cohen, 1988, p. 14). This reduced the power of the study and increased the probability of a type II error occurring.

I developed the data collection tools, which was also a potential source of bias. However, the design and development of these was very specific to the study population, with the performance tool being designed to assess the participants' performance at their current stage of development, year two. Although I followed a rigorous process, the tool was limited in its use to the participants in my study and, as a result, to use it with other learners or in different settings would require further validity and reliability tests. In addition, the fact that the raters were from one university further limited the generalisability of the findings. In relation to the knowledge and self-efficacy questionnaires, they were also very specific to the study population and focused on measuring what could actually be measured relevant to the specific elements of the SBE scenarios. They did not measure the construct of knowledge or self-efficacy, therefore, their application beyond this population would be limited.

As the study occurred in an actual curricula setting, a number of logistic and technological issues effected the results. The first was the problem with timetabling in P2 and then the issues related to the video capture in P2 and P3. This led to a number of potential violations of assumptions. Wherever possible, I attempted to overcome these using relevant statistical tests, for example, with the violation of assumptions

related to the multiple regression analysis, the bootstrap method was adopted or, following the mixed ANOVA analysis, I made corrections using the Greenhouse-Geisser method. Once again, this effected external validity and the generalisability of the findings. Nevertheless, despite these limitations it is envisaged that the results will act as a catalyst for SBE educators to incorporate Sim-TDP into their SBE deliveries or to undertake additional research into this area.

The study had a number of strengths, the first of which was the fact that it was undertaken in an existing setting and not in a “laboratory style” setting. This added credibility to the findings, which was further enhanced by using participants who were actually undertaking a nursing programme and not volunteers, ethically they could opt out of the study. Another strength included the use of standardised scenarios and debriefing methods for both arms and, the use of experienced SBE facilitators trained in the use of the Sim-TDP intervention. The use of three raters to evaluate and rate the performance of the sub-groups added strength to the study since this led to a consensus score for each sub-group thus reducing potential bias.

## **7.7 – Reflexive account**

At the start of my Professional Doctorate journey, I had a general idea that I wanted to undertake research that focused on SBE. I was passionate about this approach to healthcare education and, I wanted to gain a much deeper understanding of its use as a learning and teaching methodology, whilst, at the same time developing the evidence to support its use in healthcare education. Having used SBE for over ten years, I was cognisant of the many challenges that SBE educators faced when developing and



delivering effective SBE, especially in justifying the costs and resources associated with its provision. As I had also been part of a number of national SBE initiatives and a member of the Association for Simulated Practice in Healthcare, the UK national SBE association, I was also conscious of the national and international drive to develop the evidence base for SBE and provide quality standards for its delivery. This set the general direction of my doctorate journey since the path I chose would be towards developing and studying a method of SBE delivery that would optimise participant performance whilst maximising the resources available. A journey that was, at times, incredibly challenging that can only be described as a rollercoaster journey marked by extreme highs and lows.

One major high point was during the early stages of my research journey when I had the privilege, at an international conference, to meet Professor Ericsson who had developed the DP framework. During the meeting, I had the opportunity to discuss the Sim-TDP model and the design of my study with him. To my great surprise, my ideas were received very positively, which validated my approach and provided me with the impetus to continue with my study. Other highlights included the presentation of various elements of my study at regional, national and international conferences. These included an invite to present with esteemed colleagues at the National League of Nursing's annual education conference on the future directions of research in SBE and DP. In addition, two keynote addresses at prestigious European SBE conferences in Norway and Germany followed by a one-hour "hot topic" podium presentation at an international peer reviewed conference. More recently, an oral presentation on my research was shortlisted for best conference paper at the Society in Europe for Simulation Allied to Medicine (SESAM) annual conference.

The first major challenge was the choice of the actual research methodology and, following an exploration of my own values and past experiences I initially chose to use a qualitative approach. This was an approach that I was both familiar with and, as a nurse, one that I felt comfortable with as it reflected my professional values. However, when I reflected on the initial aim of my study, which was to provide evidence of the effectiveness of SBE as a learning and teaching methodology I began to explore a more quantitative approach. I did not want to gain an understanding of perceptions or experiences of the participants I wanted to measure their performance during an SBE encounter. Whilst the shift in philosophy was a challenge, the undertaking of a quantitative research study was a far greater one. I was not familiar with this approach and, as a result, I initially felt completely overwhelmed by the processes involved and my lack of understanding of the methodology became apparent very quickly. At this point, my own learning curve was very steep and, at times, appeared unsurmountable. I felt lost with no bearings to take me to my journey's end. It was at this time I realised that no man was an island and that support from colleagues was essential for me to continue. I was amazed at the support I received and the willingness of colleagues to help and, with their guidance, I was able to restart my journey and develop those skills required of a quantitative researcher. This included the development of a personalised study programme that included attendance at a number of face-to-face as well as virtual lectures. These proved invaluable and enabled me to develop as a quantitative researcher.

At each stage of the research process, I also met challenges that, at the time, also felt vast and, as a result, I questioned my resolve to continue the journey. These ranged from issues with data collection and organisational aspects of the study, such as the cancellation of timetabled SBE sessions through to the technical problems encountered with the audio visual system. During the actual data analysis phase I had not

anticipated the length of time it would take the performance videos to be analysed. What I had expected to take three months nearly tripled in time due to the competing demands that the raters had to juggle. It was during these times that the point was reinforced that this was not a lone journey and, that with the support, guidance and help of colleagues I was able to overcome these hurdles and continue along my doctoral path. As such, my confidence and competence as a quantitative researcher grew. This was aided by a number of opportunities to present my study at local, national and international conferences. In doing so, I had the opportunity to present, discuss and receive feedback from experts in the field on both the Sim-TDP model and my study design. This provided further verification of the Sim-TDP model and my study and, as a result, acted as a catalyst and boost to continue and, during the low periods, a much needed motivating influence to complete my study.

To summarise my research journey has been an incredibly challenging rollercoaster but, with hard work, persistence, sharing of ideas, good supervision and the support of colleagues I have been able to continue my journey. Along the way, I have learnt a prodigious amount about both SBE and the research process and, as a result, I have begun my travels as a novice researcher along the continuum towards becoming an expert.

## **7.8 - Dissemination of the study findings**

Dissemination of my study findings has been a crucial component in my doctoral journey and, an important part of the academic process, as it has enabled colleagues to not only make use of the new knowledge I have generated but, also to analyse and challenge my findings (Field, 2013, p. 34; Polit and Beck, 2010, p. 142). To this end

from the outset of my doctorate journey, I have presented elements of my study at regional, national and international conferences (Appendix 15). The most significant of these included an invite to present, with esteemed colleagues, at the National League of Nursing's annual education conference on the future directions of research in SBE and DP. In addition, the two keynote addresses at prestigious European SBE conferences in Norway and Germany, where I had the opportunity to present elements of my findings to colleagues. These were followed by a one-hour "hot topic" podium presentation on both the Sim-TDP model and the main findings of my study at an international peer reviewed conference. More recently, an oral presentation on my research was shortlisted for best conference paper at the Society in Europe for Simulation Allied to Medicine (SESAM) annual conference. The next stage in my dissemination plan is to publish the Sim-TDP model and my study findings within relevant peer reviewed educational, professional and SBE journals.

## **7.9 – Chapter conclusion**

This chapter has concluded my thesis and has charted my doctoral journey. A journey that has been incredibly challenging, having a number of major high and low points but, these have culminated in an extremely rewarding experience. The chapter began by revisiting the rationale for the choice of my doctorate before moving on to restating the research question, summarising the key study findings and outlining its distinctiveness and contribution to the SBE body of knowledge. This included the development of the Sim-TDP model and how it can provide SBE educators with a framework to optimise the performance of adult pre-registration nurses. A model that can be easily integrated into existing SBE programmes and, as such, it could amend

the delivery of SBE in the area of pre-registration adult nursing. As professional nursing regulators and educational institutes explore replacing clinical practice with simulation this potentially would be of interest to simulation based educators in nursing. In addition, it has the enormous potential to do the same in SBE delivery across healthcare education. There were limitations to the study and these, using a transparent process, have been acknowledged to enable others to judge the value of the study. The key recommendations have been summarised to show how this study might inform SBE educational practice and research. The conclusion ends with my reflexive account and dissemination plan that demonstrates that this thesis, although challenging, was not in its self an end point but part of my progress as a researcher along the novice to expert continuum and the start of my post-doctoral journey.

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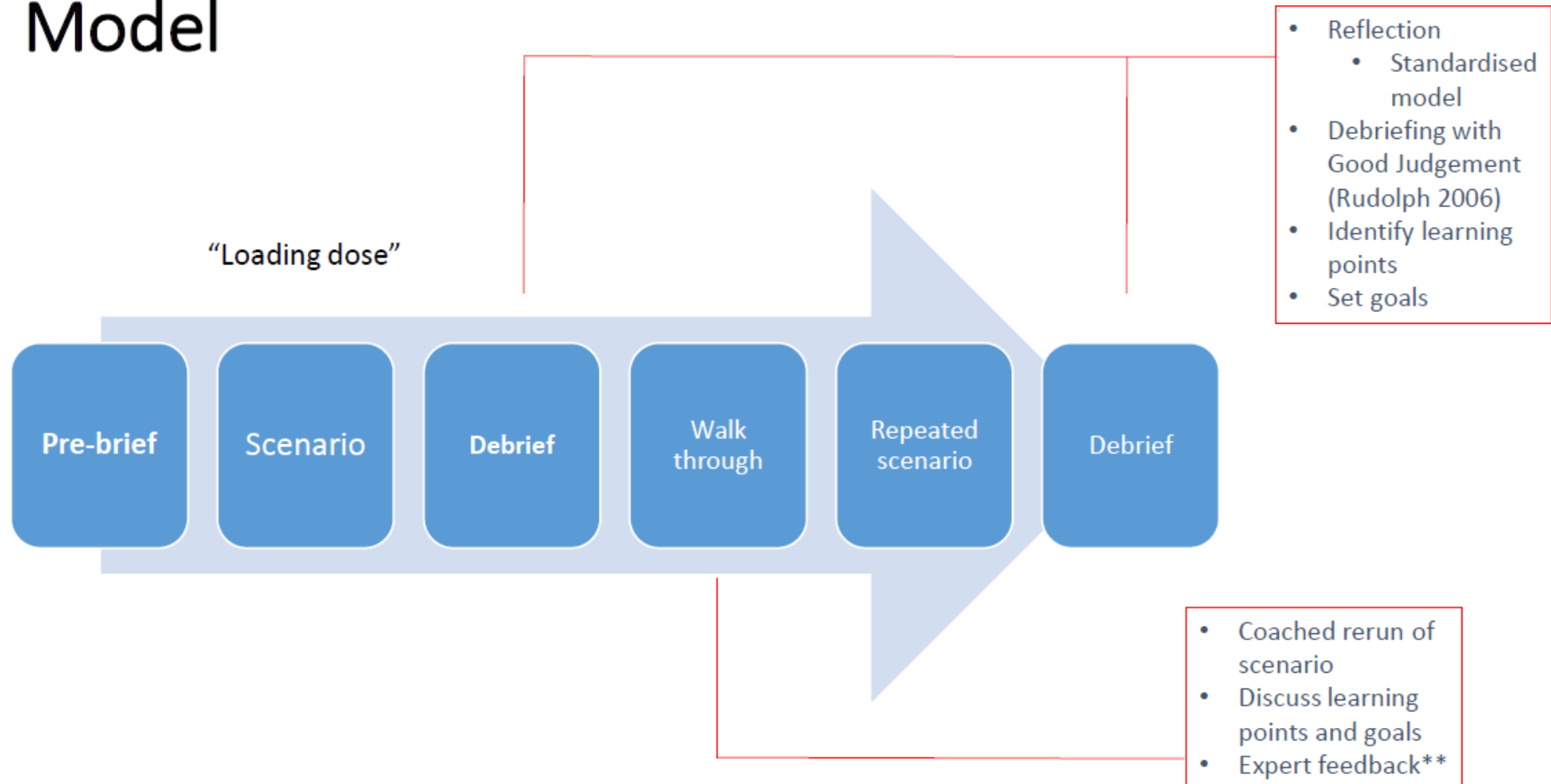
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# Appendices

# **Appendix 1 - Simulation with Team Deliberate Practice (Sim-TDP)**

# Simulation with Team Deliberate Practice - Model



## **Appendix 2 - Standardised SBE template**

# Simulation Template [Scenario Name]

## Scenario Overview

[Outline Scenario, faculty needed and roles]

## Scenario Objectives

[Document Objectives]

## Scenario Background/Candidate Instructions

You are

## Facilitator Instructions/ Candidate Prompts

[Facilitator guide including level of facilitation and role, identify candidate prompts, patient simulator/manikin settings and clinical course e.g. “on the fly” expected actions or computer programme commands]

## Debrief

[Chosen model/framework and learning points]

## Room Setup – Tech support etc

[Include tech support]

## Equipment -

Equipment	Number (1 unless stated otherwise)

Northumbria University ©





## **Appendix 3 - Standardised debriefing proforma**

# Debriefing Guide for facilitators

- 3 phases
- *Descriptive phase* -
  - This phase aims at identifying the thoughts and feelings of the students in relation to the scenarios, and allows the facilitator to clarify any underlying facts
- *Analysis phase* -
  - This phase allows the students to make sense of the simulated event through reflection “on action” and through subsequent analysis of these.
- *Application phase*
  - This phase aims to identify learning points from the scenario that the students can use to improve their practice.

(Adapted from - Steinwachs, B., (1992) How to Facilitate a Debriefing. *Simulation Gaming*; 23 (2): 186 – 195)

## **Appendix 4 - Clinical scenarios**

# AA0404/AA0503 SimMan 1 Scenario: Hypovolaemia – NEW Facilitator Guide

## Scenario Overview

The scenario will introduce the students to the early recognition, care and management of a patient with hypovolaemia due to post operative bleeding and the recognition of the patho-physiological changes in the various stages of shock.

## Scenario Objectives

Under direct supervision the student will be able to:

- Recognise the deteriorating patient.
- Assess the patient utilizing the ABCDE assessment and accurately record and report their findings.
- Hand over using the “SBAR” tool.

## Scenario Background/Student Instructions

You are a student nurse on a very busy general surgical ward and you are in the process of doing the “drugs round” with your mentor. A 50-year-old gentleman, Mr. Jones, is recovering from abdominal surgery, which he had 2 hours ago. He is currently Nil by Mouth and has intravenous therapy running.

As you approach him with his medication you notice that he looks pale, and feels cold and clammy. He appears very unsettled, shuffling around the bed trying to find a blanket.

## Facilitator Instructions/ Student Prompts

You are playing the students mentor and acting in a direct supervisory capacity. Please reinforce team roles, therapeutic touch, communication as nursing interventions.

Q.1: Is there anything in his behaviour that concerns you?

**Yes, the patient looks pale, and feels cold and clammy a sign that the patient is “shutting down” an early compensatory sign (Sympathetic stimulation). As a result he also feels cold (he wants a blanket), because of the same response. He is also unsettled and shuffling, which could be an early sign of cerebral hypoxia.**

Additional guide question.

Why are they shutting down? Preservation of major organ circulation.

**Timing 5mins for above.**

Q.2: As a team what would you do next? **Start the simulation**

**Encourage students to check previous observations (On TPR chart at bed space)**

Which were:

HR – 80 bpm

BP – 125/60 mmHg

RR – 16 bpm

Urine output – He is catheterized and his urine output has been over 70mls/hr, but the chart is now missing!

Peripheral temp – 36.8

SpO2 98% (2ltr via Nasal cannulae)

*These were normal. May want to discuss normal ranges depending on time but should have done this in year 1.*

**?Repeat observations, if so which observations would you record?**

New observations are:

**Student to do observations. Task 10 mins**

HR – 125 bpm (Thready):

**Tachycardic, a compensatory sign to improve circulating volume (Sympathetic stimulation)**

**But continues due to ongoing sympathetic stimulation, but the pulse is thready due to decreasing circulating volume.**

Capillary refill – 5 secs:

**Sluggish circulation (Normal <2 secs) due to “shutting down” a compensatory sign aimed at maintaining central perfusion to vital organs (Sympathetic stimulation)**

BP – 90/55 mmHg:

**Compensatory mechanisms failing and the blood pressure has fallen as a result.**

RR – 28 bpm: Can observe on Sim Man BUT on mega code will have to inform stds.

**Increased due anxiety, increased oxygen requirements at cellular level (Internal respiration) and increased need to eliminate carbon dioxide (Anaerobic respiration).**

Urine output – less than 20mls/hr:

**Urine output decreased due to the stimulation of the renin - angiotensin system, which further stimulates aldosterone (Retain sodium therefore water) and anti-diuretic hormone (Reduce urine output) in order to retain fluid and restore circulating volume. Additionally reduced perfusion to the kidneys would reduce glomerular filtration rate thus impacting on function further.**

Peripheral temp – 36.0 c: On Screen

**Skin temperature cooler due to the peripheries “shutting down”**

SpO2 – unable to get a signal:

**No signal due to the peripheries “shutting down” and impeding circulation.**

Q.3: What do you think is wrong?

**Hypovolaemic shock**

Q.4: What would you do?

**Inform an RN/medical colleague**

**ABC's –**

**Check airway (Confused)**

**Increase oxygen**

**Cannulate and fluids**

**Stop simulation – Follow debriefing with team deliberate practice model**

## Debrief

Use Steinwachs' 3 phase debriefing model (Adapted from - Steinwachs, B., (1992) How to Facilitate a Debriefing. *Simulation Gaming*; 23 (2): 186 – 195)

### **Descriptive phase -**

In this phase identify the thoughts and feelings of the students in relation to the scenarios, and if needed clarify any underlying facts

### **Analysis phase -**

In this phase allow the students to make sense of the simulation event through reflection.

### **Application phase**

In this phase the students should identify learning points from the scenario that can be used to improve their practice.

## Room Setup – Contact HS clinical skills / teaching and learning advisor

Arrange room to resemble a ward with identified equipment. Manikin, gender male, should be dressed in a **hospital gown** with a **wig** on. Needs urinary catheter, abdominal drain and abdominal wound

## Equipment – Contact HS clinical skills / teaching and learning advisor

Equipment	Number (1 unless stated otherwise)
Sim-man (With manual BP)	
Monitor – SpoO <sub>2</sub>	
IV cannulae – with drainage bag	
SMOTs	
Observation chart	
Care plan	
Drug Kardex + patient name band	
IV Fluids	
Fluid balance chart	
O <sub>2</sub> masks/cannulae (Various)	
Urinary catheter with drainage bag	
Redivac drain and wound dressing (Wound)	
Gloves	
Stethoscope	

## AA0404/AA0503 SimMan 1 Scenario: Asthma – NEW Facilitator Guide

### Scenario Overview

The scenario will introduce the students to the early recognition, care and management of a patient with acute asthma, and the recognition of the patho-physiological changes of asthma.

### Scenario Objectives

Under direct supervision the student will be able to:

- Recognise the deteriorating patient.
- Assess the patient utilizing the ABCDE assessment and accurately record and report their findings.
- Hand over using the “SBAR” tool.

### Scenario Background/Student Instructions

You are a student nurse on a very busy medical admissions unit and you have been allocated with your mentor into the blue area of the department. Mr Smith, a 40 year old senior marketing executive for a local advertising firm, has been admitted with abdominal pain and a two-hour history of increasing breathlessness. He is responsible for entertaining clients and ensuring that projects are completed on time. Recently there have been several important accounts handed to him and he hasn't had a day off in several weeks, often working long hours in response to project deadlines. Over the last 24 hours, he has noticed that he has an increased tightness in his chest, and a dry non-productive cough, which he put down to being run down. Mr Smith has suffered from asthma since he was fourteen years old, and although his breathlessness has been better since he stopped smoking (approximately seven years ago), when entertaining he is quite regularly exposed to smoky atmospheres, and as a result suffers from a tight chest up to several times a week which he self manages using inhalers.

Apart from his inhalers, the only other medication he has been taking is aspirin for headache and ibuprofen for a knee injury sustained when playing squash with clients 2 days ago. Mr Smith is currently able to speak in short sentences and has a peripheral saturation of 90% on room air. When you return to Mr Smith approximately 45 minutes later his breathlessness has become progressively worse and he can only manage a couple of words each breath. He appears visibly distressed with his breathing and he has an audible wheeze despite repeatedly using his inhalers. He is receiving 28% oxygen but is reluctant to keep his facemask in situ, and now appears agitated and slightly disorientated. His peripheries are warm but there is clear evidence of peripheral cyanosis. He appears flushed and is perspiring freely (diaphoresis), his breathing is very shallow with nasal flaring



## Facilitator Instructions/ Student Prompts

You are playing the students mentor and acting in a direct supervisory capacity. Please reinforce team roles, therapeutic touch, communication as nursing interventions.

*Please reinforce team roles, therapeutic touch, communication as nursing interventions.*

**Baseline Observations are as follows:** On Chart at bottom of bed.

Resps: 22

Pulse: 97

BP: 125/95

Temp: 37.6 Oxygen Sats: 90% on room air (slight evidence of peripheral cyanosis).

Peak flow 300 (normal is about 450).

**Q.1: Is there anything in his behaviour that concerns you?**

Go through verbal and non verbal signs.

**Q.2: What are your initial impressions?**

i.e. ?stress-anxiety attack or MI?

**His observations are: Students to do obs and complete chart.**

Resps: 28

Pulse: 110, Stds to do Manual Pulse, may have to increase pulse on sim man

BP: 145/100 Stds to do Manual BP, may have to increase sound on sim man

(Sympathetic overdrive, compensatory response to respiratory failure/shock)

Temp: 37.6 On screen

Oxygen Sats: 88% on 28% oxygen (central cyanosis secondary to respiratory failure) On Screen

Unable to perform peak flow - agitation due to cerebral hypoxia

Auscultation of the chest reveals generalised inspiratory and (prolonged) expiratory wheezes (passive process, high airway resistance) ?take out????

**Q.3: As a team what would you do next?**

**Do not try to move Sim doll unless use bed, due to moving and handling.**

*Position- maximise airway sit upright in bed*

*Obtain baseline observations- For comparison and what not normal*

*ABC assessment- Linked to above*

*Peak flow measurement- extent of respiratory failure (see later note)*

*Oxygen therapy following discussion with RN / Medical staff.*

**NB.**(COPD type patients become sensitive to low PaCO<sub>2</sub> high O<sub>2</sub> could reduce respiratory drive causing hypercapnia and lowering pH, however these are small numbers and hypoxia will kill much faster than hypercapnia)

*Inhalers as necessary – link to Sem on care of resp pt.*

*Secure IV access (large bore)- discuss why need this i.e. IV drugs*

**Continued**

## Continued

*Call for assistance (RN/medical staff)-oxygen needs reviewed, needs further interventions.*

***Increase Oxygen to 100% -discuss prescription and emergency situation.***

***Recheck observations Students to do obs and complete chart.***

*Reassure patient- ongoing and once settled, may want to discuss if family were present what would the stds do?*

**Q.What do you think is wrong? Summarize your findings for the Dr who has just arrived?**

*Mr Smith is a 40 year old male, presenting with a two hour history of increasingly acute breathlessness, unable to complete full sentences. Known asthmatic has used his inhalers to no effect. Appears agitated and slightly disorientated, peripheries are warm but there is evidence of peripheral cyanosis.*

**Q. What would you do and what imminent investigations would you expect?**

**What investigations would you expect to be ordered? Need why**

*Chest X Ray*

*ECG*

*ABG's*

**Would there be any additional treatment at this stage?**

*Nebulisers (initially, salbutamol, if little response combine with ipratropium, in extremis/anaphylaxis adrenaline, but beware arrhythmias, tachycardia, cold peripheries)- may need to follow up with IV preparations*

*Steroids (oral prednisilone 40-50mg per day, or IV hydrocortisone 100mg QDS)*

**Timings max 10 mins**

**Stop simulation – Follow debriefing with team deliberate practice model**

## Debrief

Use Steinwachs' 3 phase debriefing model (Adapted from - Steinwachs, B., (1992) How to Facilitate a Debriefing. *Simulation Gaming*; 23 (2): 186 – 195)

### **Descriptive phase -**

In this phase identify the thoughts and feelings of the students in relation to the scenarios, and if needed clarify any underlying facts

### **Analysis phase -**

In this phase allow the students to make sense of the simulation event through reflection.

### **Application phase**

In this phase the students should identify learning points from the scenario that can be used to improve their practice.

## Room Setup – Contact HS clinical skills / teaching and learning advisor

Arrange room to resemble a ward with identified equipment. Manikin, gender male, should be dressed in **clothes (Shirt & trousers)** with a **wig** on.

## Equipment – Contact HS clinical skills / teaching and learning advisor

Equipment	Number (1 unless stated otherwise)
Sim-man (With manual BP)	
Monitor – SpoO <sub>2</sub>	
SMOTs	
Observation chart	
Care plan	
Drug Kardex + patient name band	
Drugs – Inhalers salbutamol / ipratropium, oral prednisilone, IV hydrocortisone	
Fluid balance chart	
Peak flow & chart	
O <sub>2</sub> masks/cannulae (Various), nebuliser	
IV cannulae and fluids	
Gloves	
Stethoscope	

# AA0404/AA0503 SimMan 2 Scenario: Chest pain – Facilitator Guide

## Scenario Overview

The scenario will introduce the students to the early recognition, care and management of a patient with chest pain (Angina) and the recognition of the patho-physiological changes in the various stages of shock.

## Scenario Objectives

Under indirect supervision the student will be able to:

- To assess the patient utilising the ABCDE assessment mnemonic and demonstrating accurate record keeping.
- To communicate effectively with all members of the team, and hand over using the “SBAR” mnemonic tool

## Scenario Background/Student Instructions

You are a student nurse on a very busy surgical ward and you have been assigned a 6 bedded bay with your mentor, it is early morning and the breakfasts are being distributed. Your mentor is currently attending to another patient. One of the patient's in your care is Fred, a 65-year-old gentleman, who was boarded out to your ward during the night due to bed pressures. He was admitted for management of his heart failure and is now due to go home. He is overweight, sedentary and smokes 20 per day. He drinks socially most evenings and weekends. Since his transfer he has been very anxious expressing concerns that this is a surgical ward and he will not see his consultant and he wants to go home? Will he get his right medication, it is breakfast and he has not had his antacid? He is also Furosemide and Enalapril. He now looks very distressed is holding his chest and looks very pale.

You hold his hand to reassure him and he feels very cold and clammy. He is also complaining of a severe pain in his chest.

## Facilitator Instructions/ Student Prompts

You are playing the students mentor and acting in an indirect supervisory capacity, therefore “step back” to allow students the opportunity to start assessing Fred. Please reinforce team roles, therapeutic touch, communication as nursing interventions.

### Facilitator Instructions/Participant Prompts

Is there anything in his behaviour that concerns you?

**Yes, the patient looks pale, and feels cold and clammy a sign that the patient is “shutting down” an early compensatory sign (Sympathetic stimulation). As a result he also feels cold (he wants a blanket), because of the same response. He is also unsettled and shuffling, which could be an early sign of cerebral hypoxia.**

As a team what would you do next? **Start the simulation**

### Check previous observations (On TPR chart)

Which were:

HR – 86 bpm

BP – 140/85 mmHg

RR – 18 bpm

Urine output – He is has been passing urine.

**Peripheral temp – 36.8 c**

SpO2 94% (Room air)

**Repeat observations, if so which observations would you record?** New observations are:

HR – 112 bpm:

**Tachycardic, a compensatory sign to improve circulating volume (Sympathetic stimulation). This however, increases the “work” of the heart and as a result increases the oxygen demands of the heart, which could lead to cardiac ischaemia and reduction in cardiac function. If used the 3 lead ECG demonstrates ST depression.**

Capillary refill – 3 secs:

**Sluggish circulation (Normal <2 secs) due to “shutting down” a compensatory sign aimed at maintaining central perfusion to vital organs (Sympathetic stimulation). This can have further adverse effects on the heart as the increase in peripheral resistance increases after-load and reduces cardiac output.**

BP – 160/105 mmHg:

**Hypertensive due to sympathetic drive and anxiety. This however, increases the “work” of the heart and as a result increases the oxygen demands of the heart, which could lead to cardiac ischaemia and reduction in cardiac function**

RR – 28 bpm:

**Increased oxygen requirements at cellular level (Internal respiration) and increased need to eliminate carbon dioxide (Anaerobic respiration).**

Urine output – Has not passed urine:

Urine output decreased due to the stimulation of the renin - angiotensin system, which further stimulates aldosterone (Retain sodium therefore water) and anti-diuretic hormone (Reduce urine output) in order to retain fluid and restore circulating volume. This retained fluid can further overload the heart.

Peripheral temp – 36.0 c:

Skin temperature cooler due to the peripheries “shutting down”

SpO<sub>2</sub> - 93%:

There is a poor signal due to the peripheries “shutting down”

What do you think is wrong?

Cardiac in origin e.g. Angina? MI (If greater than 20 mins), pericarditis, dissecting aortic aneurysm.

Possible gastro in origin e.g. gastric reflux, ulcers.

Pulmonary in origin pulmonary e.g. embolism, or pneumothorax

What would you do?

Initial assessment, start thinking of:

Airway (Check if clear, oxygen etc)

Breathing (Resp rate, SpO<sub>2</sub>, resp. assessment etc )

Circulation (Hr, BP, ECG Cardiac monitor, 12 lead, IV cannula and bloods - cardiac enzymes/FBC etc)

Disability (AVPU – Alert, responds to Voice, Pain, Unresponsive. Bm etc ),

Exposure (Skin colour, Temp etc)

Assess pain (Site, onset, duration, frequency, severity, radiation, nature, associated symptoms, precipitating factors and relieving factors).

Reassurance and psychological support

Urgent referral to an RN/medical colleague

GTN as prescribed

Analgesia as prescribed

(MONA - Morphine, Oxygen, Nitrates and Aspirin)

(MOVE – Monitor, Oxygen, IV access, ECG)

Regular observations/close monitoring.

NSF – CHD (2000) interventions:

Aspirin (at least 300mg orally, if not already given)

Oxygen

Pain relief (e.g. 2.5 to 5mg diamorphine i.v., 5 to 10mg morphine i.v. with anti-emetic, if still in pain)

Thrombolytic therapy (given WITHOUT DELAY, i.e. within an hour of the onset of symptoms)

Beta-blockers (to be continued for at least one year) Contraindicated due to heart failure.

ACE inhibitors (review after four to six weeks) ??

**What would you do?**

Inform an RN/medical colleague

ABC's –

Check airway (Confused)

Increase oxygen

Cannulate and fluids

**Stop simulation – Follow debriefing with team deliberate practice model**

## Debrief

Use Steinwachs' 3 phase debriefing model (Adapted from - Steinwachs, B., (1992) How to Facilitate a Debriefing. *Simulation Gaming*; 23 (2): 186 – 195)

### **Descriptive phase -**

In this phase identify the thoughts and feelings of the students in relation to the scenarios, and if needed clarify any underlying facts

### **Analysis phase -**

In this phase allow the students to make sense of the simulation event through reflection. In this phase use **6 phase approach** and **bookmarks** to identify/discuss students performance.

### **Application phase**

In this phase the students should identify learning points from the scenario that can be used to improve their practice.

## Room Setup – Contact HS clinical skills / teaching and learning advisor

Arrange room to resemble a surgical ward with identified equipment. Manikin, gender male, should be dressed in **pyjamas/clothes**.

## Equipment – Contact HS clinical skills / teaching and learning advisor

Equipment	Number (1 unless stated otherwise)
Sim-man (With manual BP)	
Monitor (Pulse oximeter)	
SMOTs	
Observation chart – initial observations recorded (See above)	
Care plan	
Drug Kardex	
O <sub>2</sub> masks/cannulae (Various)	
ECG - 3 lead	
ECG – 12 lead	
GTN spray & Buccal	
Bm machine	
Urine bottle	
Vomit bowel	
Gloves	
Stethoscope	



# AA0404/AA0503 SimMan 2 Scenario: Sepsis – Facilitator Guide

## Scenario Overview

The scenario will introduce the students to the early recognition, care and management of a patient with sepsis due to a urinary tract infection and the recognition of the patho-physiological changes in the various stages of shock.

## Scenario Objectives

Under indirect supervision the student will be able to:

- To assess the patient utilising the ABCDE assessment mnemonic and demonstrating accurate record keeping.
- To communicate effectively with all members of the team, and hand over using the “SBAR” mnemonic tool

## Scenario Background/Student Instructions

You are working on a medical admissions unit and you have just started your shift in the blue area when a Health Care Assistant (HCA) asks you to review Florence. Your mentor is currently attending to another patient.

Florence is a 65 year old lady, who was admitted 4 hours ago following a GP referral. She presented with a 3 day history of feeling very “unwell” and increasing confusion over the last 24 hrs. Although a poor historian Florence did complain of an uncomfortable feeling in her tummy and that she needed the toilet a lot, but it hurt when she did go. A urinary tract infection was diagnosed and following a microbiology screen she was commenced on IV antibiotics and intravenous fluids 2 hrs ago, and was also given paracetamol at this time.

As you approach Florence you notice that she looks flushed and appears very restless, and when you touch her hand to reassure her she feels hot and sweaty.

## Facilitator Instructions/ Student Prompts

You are playing the students mentor and acting in an indirect supervisory capacity, therefore “step back” to allow students the opportunity to start assessing Florence. Please reinforce team roles, therapeutic touch, communication as nursing interventions.

### Facilitator Instructions/Participant Prompts

Is there anything in his behaviour that concerns you?

**Yes!**

*Facilitator answers:*

**Appears flushed and sweaty:** *peripheral vaso-dilation in response to pyrexia indicating inflammation or infection.*

**She is restless:** *A subjective observation but could be an early sign of cerebral hypoxia.*

**They need more information e.g. observations and history to further assess Florence before they call for help.**

As a team what would you do next? **Start the simulation**

### Check previous observations (On TPR chart)

Which were:

HR – 90 bpm

BP – 118/55 mmHg

RR – 18 bpm

Urine output – Not catheterized but passed 60 mls on admission a urinalysis was performed at this time (SG 1020, blood +++, protein +++).

**Peripheral temp – 37.8 c**

SpO2 96% (Room air)

Repeat observations, if so which observations would you record? Current observations are:

HR – 100 bpm:

**Tachycardic, a compensatory sign to improve circulating volume (Sympathetic stimulation), and this is bounding due to the inflammatory response causing a hyper-dynamic circulation and vaso-dilation.**

Capillary refill – 2 secs:

**Normal due to the inflammatory response causing a hyper-dynamic circulation. The normal compensatory mechanism of “shutting down” aimed at maintaining central perfusion to vital organs (Sympathetic stimulation) when in “shock” is overridden by vaso-dilation**

BP – 112/46 mmHg:

**Normal compensatory mechanisms maintaining systolic BUT diastolic has gone down a sign of decreased resistance in the peripheral circulation again due to vaso-dilation.**

RR – 26 bpm:

**Raised due to a hyper-metabolic state causing increased oxygen requirements at cellular level (Internal respiration) and increased need to eliminate carbon dioxide (Anaerobic respiration).**

**Urine output – None passed since admission:**

**Urine output decreased due to the stimulation of the renin - angiotensin system, which further stimulates aldosterone (Retain sodium therefore water) and anti-diuretic hormone (Reduce urine output) in order to retain fluid and restore circulating volume. ? Catheterize.**

Peripheral temp – 37.8°C:

**Indicating inflammation or infection, although it could be argued that the pyrexia is not too high, this may not be a true reading as she has been prescribed paracetamol**

SpO<sub>2</sub> - 96%:

**Normal**

What do you think is wrong?

**Early signs of sepsis (Hot shock).**

What would you do?

**Inform an RN/medical colleague, start thinking of ABC's (E.g. starting oxygen and checking for IV cannula, which has tissue) and start regular observations/close monitoring.**

**The blood pressure is “normal” but there are a number of warning signs or “cues” that could alert the health care professional to a potential deterioration in the patient.**

**•Oxygen should be given even though SpO<sub>2</sub> is 96% because the concern would be that the delivery of O<sub>2</sub> at a cellular level may be impaired due to the sepsis process (Hinders oxygen uptake at a cellular level) and hypo-perfusion (MAP low).**

**What would you do?**

Inform an RN/medical colleague

ABC's –

Check airway (Confused)

Increase oxygen

Cannulate and fluids

**Stop simulation – Follow debriefing with team deliberate practice model**

## Debrief

Use Steinwachs' 3 phase debriefing model (Adapted from - Steinwachs, B., (1992) How to Facilitate a Debriefing. *Simulation Gaming*; 23 (2): 186 – 195)

### **Descriptive phase -**

In this phase identify the thoughts and feelings of the students in relation to the scenarios, and if needed clarify any underlying facts

### **Analysis phase -**

In this phase allow the students to make sense of the simulation event through reflection. In this phase use **6 phase approach** and **bookmarks** to identify/discuss students performance.

### **Application phase**

In this phase the students should identify learning points from the scenario that can be used to improve their practice.

## Room Setup – Contact HS clinical skills / teaching and learning advisor

Arrange room to resemble a medical admissions unit with identified equipment. Manikin, gender female, should be dressed in **pyjamas/clothes** with a **wig** on.

## Equipment – Contact HS clinical skills / teaching and learning advisor

Equipment	Number (1 unless stated otherwise)
Sim-man (With manual BP)	
Monitor (Pulse oximeter)	
IV cannulae – with drainage bag	
SMOTs	
Observation chart – initial observations recorded (See above)	
Care plan	
Drug Kardex – name band	
Fluid balance chart	
IV fluids	
O <sub>2</sub> masks/cannulae (Various)	
ECG - 3 lead	
Vomit bowel	
Gloves	
Stethoscope	

## **AA504 “SIM MAN” Scenario: Chest pain/MI** **– Facilitator guide.**

### **Scenario Overview**

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The scenario will introduce the students to the care/management of a patient with chest pain leading to myocardial infarction. The students will utilize the resuscitation councils advanced life support guidelines and follow an ABCDE assessment and discuss expected treatment.

### **Scenario Objectives**

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To allow the student to:

- Recognise the deteriorating patient
- To assess the patient utilising the ABCDE assessment mnemonic, and demonstrating accurate record keeping.
- To communicate effectively with all members of the team, and hand over using the “SBAR” mnemonic tool
- Discuss the resuscitation councils advanced life support guidelines.

### **Scenario Background/Participant Instructions**

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You are a staff nurse working in A & E when a man/woman is brought in by a friend. He/she is complaining of severe chest pain and is holding his/her chest and looks very distressed and very pale.

There friend informs you that they are both taxi drivers and John/Joan after dropping a client off started to complain of chest pain, which has now lasted approximately 25 minutes ago. You hold his/her hand to reassure him/her and he/she feels very cold and clammy.

### Facilitator Instructions/Participant Prompts

You are playing the role of the students mentor/clinical supervisor, but allow them to lead the scenario, and only intervene when called.

**Introduction** - Give the students the scenario background.  
Further patient information – if asked for:

- Time/date – 12 pm, lunch time
- Age - 55
- Gender – male/female
- Presenting complaint – severe chest pain
- Pain
  - Site – central chest
  - Onset – Approximately 10 minutes ago
  - Duration – 10 minutes
  - Frequency - continuous
  - Severity – On a scale of 1 – 10 = 10
  - Radiation – Up into jaw and down left arm
  - Nature – Described as “crushing” and “being in a vice”
  - Associated symptoms - nausea
  - Precipitating factors – walking around/movement
  - Relieving factors- None, tried normal antacid but no effect and tried GTN spray but again no effect
- Past medical history – Heart burn and angina (4 years), but this has got worse over the last 3 months
- Allergies - None
- Drug history – Antacid, GTN
- Social history – Lives with family, husband/wife and two teenage girls
  - Smoker – Yes, a packet a day
  - Alcohol – Yes, has a couple of drinks/day but more at the weekend
- Family history – Dad died of a “heart attack” aged 62
- Differential diagnosis – Unstable angina

**Start (Part 1 Assessment)** - Ask them to start assessing the patient (**Start scenario**)

- **Initial assessment, see below for observations**, start thinking of:

- Airway (Check if clear, oxygen etc)
- Breathing (Resp rate, SpO<sub>2</sub>, resp. assessment etc )
- Circulation (Hr, BP, ECG Cardiac monitor, 12 lead, IV cannula and bloods - cardiac enzymes/FBC etc)
- Disability (AVPU – Alert, responds to Voice, Pain, Unresponsive. Bm etc ),
- Exposure (Skin colour, Temp etc)
- Assess pain (Site, onset, duration, frequency, severity, radiation, nature, associated symptoms, precipitating factors and relieving factors).
- Reassurance and psychological support

#### Examination:

The patient looks pale, and feels cold and clammy a sign that the patient is “shutting down” an early compensatory sign (Sympathetic stimulation). He/she is also unsettled and shuffling, which could be an early sign of cerebral hypoxia.

#### Observations:

##### **HR – 112 bpm:**

Tachycardic, a compensatory sign to improve circulating volume (Sympathetic stimulation). This however, increases the “work” of the heart and as a result increases the oxygen demands of the heart, which could lead to cardiac ischaemia and reduction in cardiac function.

##### **Capillary refill – 3 secs:**

Sluggish circulation (Normal <2 secs) due to “shutting down” a compensatory sign aimed at maintaining central perfusion to vital organs (Sympathetic stimulation). This can have further adverse effects on the heart as the increase in peripheral resistance increases after-load and reduces cardiac output.

##### **BP – 160/105 mmHg:**

Hypertensive due to sympathetic drive and anxiety. This however, increases the “work” of the heart and as a result increases the oxygen demands of the heart, which could lead to cardiac ischaemia and reduction in cardiac function

##### **RR – 28 bpm:**

Increased oxygen requirements at cellular level (Internal respiration) and increased need to eliminate carbon dioxide (Anaerobic respiration).

##### **Urine output – Has not passed urine:**

Urine output decreased due to the stimulation of the renin - angiotensin system, which further stimulates aldosterone (Retain sodium therefore water) and anti-diuretic hormone



(Reduce urine output) in order to retain fluid and restore circulating volume. This retained fluid can further overload the heart.

**Peripheral temp – 36.0 c:**

Skin temperature cooler due to the peripheries “shutting down”

**SpO2 - 93%:**

There is a poor signal due to the peripheries “shutting down”

- Urgent referral to an RN/medical colleague
  - **Call for help - SBAR handover**
- Regular observations/close monitoring. (MOVE – Monitor, Oxygen, IV access, ECG)
- (MONA - Morphine, Oxygen, Nitrates and Aspirin)
- GTN as prescribed
- Analgesia as prescribed

NSF – CHD (2000) interventions:

- Aspirin (at least 300mg orally, if not already given)
- Oxygen
- Pain relief (e.g. 2.5 to 5mg diamorphine i.v., 5 to 10mg morphine i.v. with anti-emetic, if still in pain)
- Thrombolytic therapy (given WITHOUT DELAY, i.e. within an hour of the onset of symptoms)
- Beta-blockers (to be continued for at least one year)  
Contraindicated in heart failure.
- ACE inhibitors (review after four to six weeks)

**Arrest (Part 2)** – After approximately 10 minutes (Not fixed some students may be quicker than others) during the above assessment the patient arrests (Scenario prompt - **Worsens**)

Follow BLS/ALS guidelines (Resuscitation Council 2010)

Shockable rhythms (VF/VT)

Action:

Start BLS

Demonstrate:

Attempt defibrillation (one shock - 150-200 J biphasic or 360 J monophasic).

Immediately resume chest compressions (30:2) without reassessing the rhythm or feeling for a pulse.

Continue CPR for 2 min, and then pause briefly to check the monitor

If VF/VT persists:  
Give a further (2nd) shock (150-360 J biphasic or 360 J monophasic).  
Resume CPR immediately and continue for 2 min.  
Pause briefly to check the monitor.

If VF/VT persists give (3rd) shock (150-360 J biphasic or 360 J monophasic) Resume CPR immediately followed immediately by adrenaline 1 mg IV and amiodarone 300 mg IV continue CPR for 2 min.  
Pause briefly to check the monitor.

If VF/VT persists give a (4th) shock (150-360 J biphasic or 360 J monophasic). Resume CPR immediately and continue for 2 min.  
Give adrenaline 1 mg IV immediately after alternate shocks (i.e. approximately every 3-5 min).  
Give a further shock after each 2 min period of CPR and after confirming that VF/VT persists.

Discuss if organised electrical activity is seen during this brief pause in compressions, check for a pulse.  
If a pulse is present, start post-resuscitation care.  
If no pulse is present, continue CPR and switch to the non-shockable algorithm. If asystole is seen, continue CPR and switch to the non-shockable algorithm.

**Stop simulation – Follow debriefing with team deliberate practice model**

## Debrief

Follow debriefing form.

## Room Setup

Arrange room to resemble an A & E with identified equipment. Manikin, gender male/female, should be dressed in **clothes** with a **wig** on.

## Equipment

Equipment	Number (1 unless stated)
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	<b>otherwise)</b>
Sim-man (With manual BP)	
Monitor	
IV cannulae – with drainage bag	
SMOTs	
*Observation chart	
*A & E chart	
*Drug Kardex	
*Emergency drugs – Adrenaline, Atropine , amiodarone etc.	
*Fluid balance chart	
O <sub>2</sub> masks/cannulae (Various)	
ECG - 3 lead	
Vomit bowel	
Stethoscope	
“Crash trolley” – airway equipment	
Defibrillator AED/Automatic	
*Algorithms (BLS/ALS)	
Pen torch	
Syringes/needles	
Aprons/gloves/handwash	

## **AA504 “SIM MAN” Scenario: Anaphylaxis – Facilitator guide.**

### **Scenario Overview**

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The scenario will introduce the students to the care/management of a patient with sepsis and the various stages of shock. They will use ABCDE assessment and discuss expected treatment e.g. O<sub>2</sub>, fluid replacement etc.

### **Scenario Objectives**

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To allow the student to:

- Recognize the deteriorating patient
- To assess the patient utilising the ABCDE assessment mnemonic, and demonstrating accurate record keeping.
- To communicate effectively with all members of the team, and hand over using the “SBAR” mnemonic tool
- Discuss the resuscitation council's anaphylaxis.

### **Scenario Background/Participant Instructions**

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Emma, a 22 year old University student, has been admitted to Accident & Emergency after complaining of a severe headache, photophobia and nausea and vomiting. Additionally, she is very reluctant to move her head. She is drowsy and gives inappropriate responses to simple questions. On closer examination, it is also noted that she has numerous lesions on her trunk and abdomen which do not disappear when pressed with a glass tumbler. Her family is not with her as they live in Edinburgh but she is accompanied by two of her fellow students.

As she is originally from Edinburgh, there are no previous medical notes to refer to. Her friends know little of Emma's medical history, other than that she suffers from asthma for which she occasionally uses her blue inhaler.

The medical staff have diagnosed Emma as having meningococcal meningitis and prescribed I.V. Benzyl penicillin which she requires as a matter of urgency. Having observed your Mentor and another qualified nurse drawing up the medication in the treatment room, you accompany your Mentor as she administers the bolus to Emma.

Immediately after administering the medication, Emma becomes extremely agitated, grasping at her throat. You notice that she has developed noisy breathing and that there is a red rash developing around her neck and chest.

### Facilitator Instructions/Participant Prompts

**Introduction** - You are playing the role of the students mentor/clinical supervisor, but allow them to lead the scenario, and only intervene when called.

Give the students the scenario background.

**Start** - Ask students to start assessing the patient (**Start scenario**)

- Initial assessment – **see below for observations**, start thinking of:
  - Airway (Check if clear, oxygen etc)
  - Breathing (Resp rate, SpO<sub>2</sub>, resp. assessment etc )
  - Circulation (Hr, BP, ECG Cardiac monitor, 12 lead, IV cannula and bloods – U/E's FBC etc)
  - Disability (AVPU – Alert, responds to Voice, Pain, Unresponsive. Bm etc ),
  - Exposure (Skin colour, Temp etc)
- Reassurance and psychological support

Current observations are: (**Prompts in red facilitator can adjust manually or described to students**):

**HR – 120 bpm (But rises as scenario continues):**

Tachycardic, a compensatory sign to improve circulating volume (Sympathetic stimulation), and this is bounding due to the inflammatory response causing a hyper-dynamic circulation and vaso-dilation.

**Capillary refill – 2 secs (But extends as scenario continues):**

Initially was normal due to the inflammatory response causing a hyper-dynamic circulation. The normal compensatory mechanism of “shutting down” aimed at maintaining central

perfusion to vital organs (Sympathetic stimulation) when in “shock” is overridden by vaso-dilation. **Beginning to extend as relative hypovolaemia worsens, extremities become cooler.**

**BP – 90/40 mmHg (But falls as scenario continues):**

Normal compensatory mechanisms maintaining systolic BUT diastolic has gone down a sign of decreased resistance in the peripheral circulation again due to vaso-dilation.

**RR – 28 bpm (But rises as scenario continues):**

Raised due to a hyper-metabolic state causing increased oxygen requirements at cellular level (Internal respiration) and increased need to eliminate carbon dioxide (Anaerobic respiration).

Noisy (Stridor) due to increasing oedema in airways (pharyngeal/laryngeal oedema).

**Urine output – None passed since admission:**

Urine output decreased due to the stimulation of the renin - angiotensin system, which further stimulates aldosterone (Retain sodium therefore water) and anti-diuretic hormone (Reduce urine output) in order to retain fluid and restore circulating volume. ? Catheterize.

**Peripheral temp – 38.8°C:**

Indicating inflammation or infection, although it could be argued that the pyrexia is not too high, this may not be a true reading as she has been prescribed paracetamol

**SpO2 - 90% (But falls as scenario continues):**

Continuing to fall due to airway problems and increased metabolic demands, which increases oxygen requirements at cellular level (Internal respiration) and increases the need to eliminate carbon dioxide (Anaerobic respiration)?

Ask the students what do you think is wrong?

Anaphylaxis.

Ask what would you do?

- Urgent referral to an RN/medical colleague
  - **Use SBAR handover**
- Follow resuscitation council guidelines (2008) on the management of anaphylaxis

- Stop any drug suspected of causing an anaphylactic reaction (e.g., stop intravenous infusion of a gelatin solution or antibiotic).
- **Adrenaline** – (*give IM unless experienced with IV adrenaline*) IM doses of 1:1000 adrenaline (repeat after 5 min if no better) Adult 500 micrograms IM (0.5 mL)
- **Establish airway**
- **High flow oxygen**
- **Monitor (If not already)** - ECG, blood pressure, pulse oximetry
- **IV fluid challenge** – Adult - 500 – 1000 mL (Stop IV colloid if this might be the cause of anaphylaxis)
- **Chlorphenamine** – (IM or slow IV) Adult 10 mg
- **Hydrocortisone** – (IM or slow IV) Adult 200 mg
- Regular observations/close monitoring.

**Stop simulation – Follow debriefing with team deliberate practice model**

### Debrief

Follow debriefing form.

### Room Setup

Arrange room to resemble an A & E with identified equipment. Manikin, gender female, should be dressed in **clothes** with a **wig** on.

### Equipment

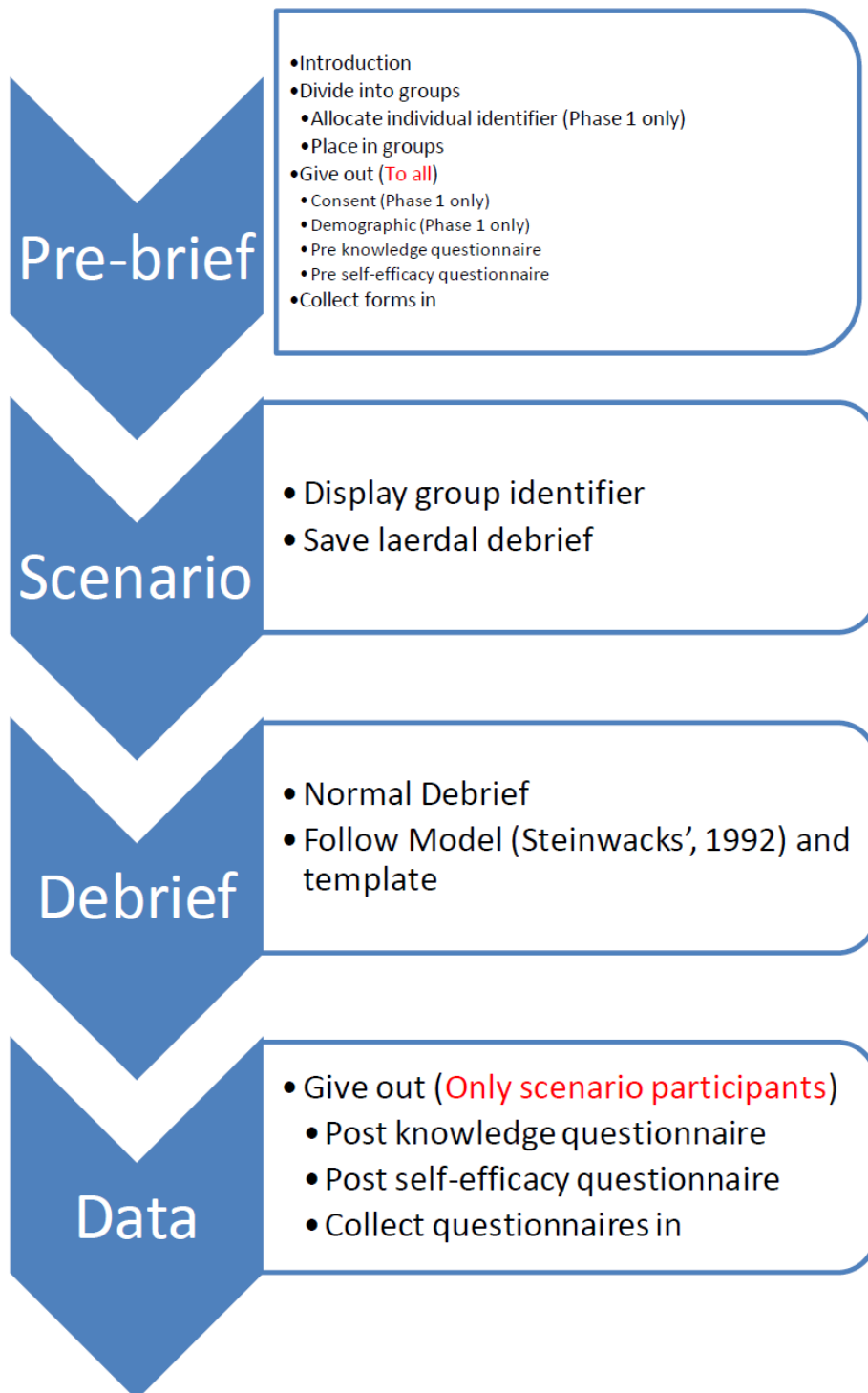
Equipment	Number (1 unless stated otherwise)
Sim-man /Mega Code (With manual	

BP)	
Monitor	
IV cannulae – with drainage bag	
SMOTs	
*Observation chart	
*A & E chart	
*Drug Kardex; Anti biotic Benzyl Penicillin	
*Emergency drugs – Adrenaline, Chlorphenamine, hydrocortisone etc.	
Fluids	
*Fluid balance chart	
O <sub>2</sub> masks/cannulae (Various)	
ECG - 3 lead	
Vomit bowel	
Stethoscope	
“Crash trolley” – airway equipment etc	
Syringes/needles	
Algorithm (Anaphylaxis)	
Pulse oximeter	
Dyna Map	
Portable suction	
Aprons /gloves /hand wash	

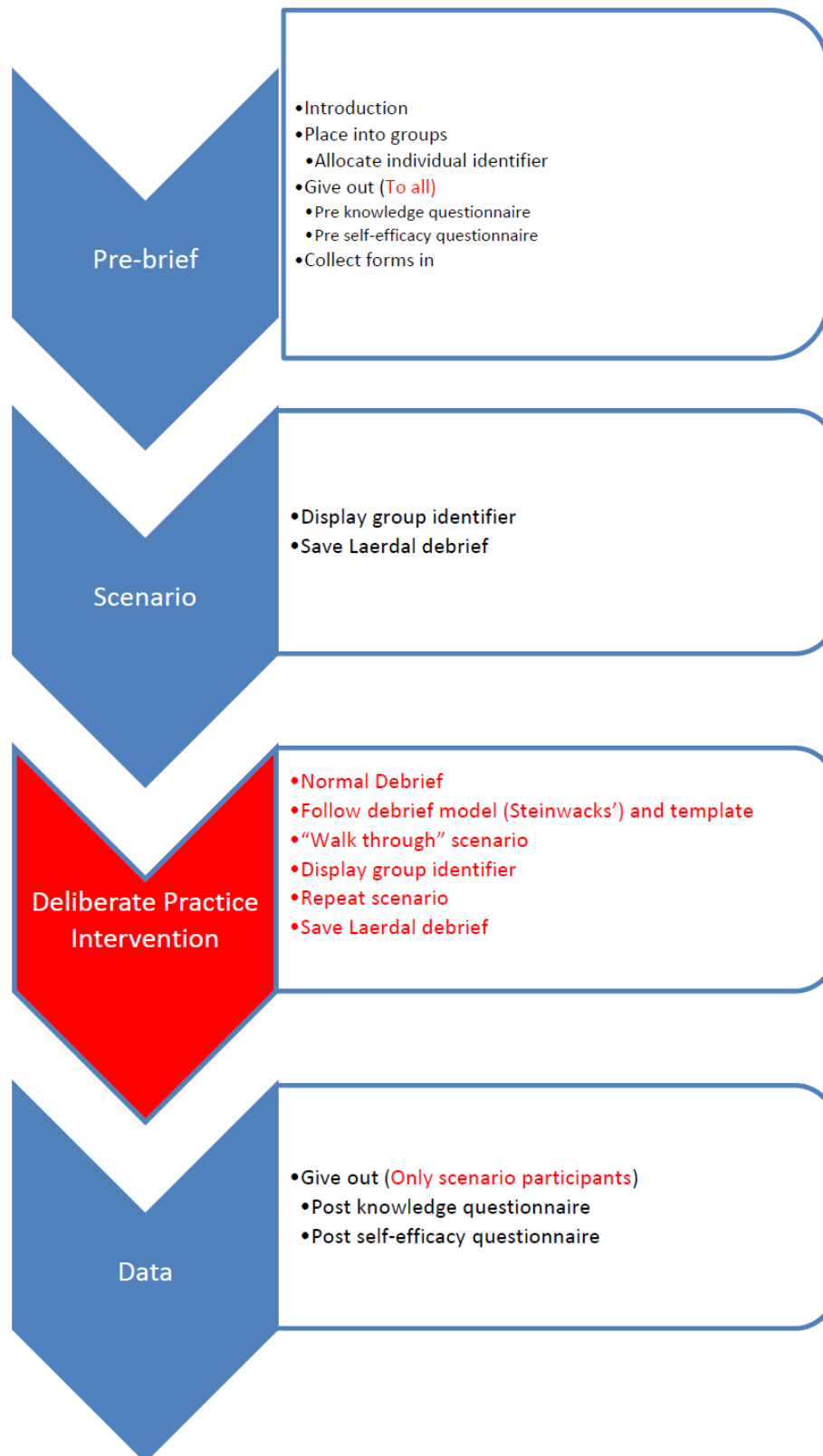


## **Appendix 5 - Facilitator guidelines**

# Comparison group guide



# Intervention group guide



### Simulation session aims:

- Recognise the deteriorating patient
- Assess the patient utilising the “ABCDE” assessment framework and accurately record findings
- Report findings and hand over using “SBAR” tool.

### Scenario outline:

- See hypovolaemia scenario guide

### Facilitator role:

- Mentor

### Facilitation guidance:

- Introduce students to mannequin and environment.
- “Hand over” scenario
- Respond to direct questions from students e.g. can we attach oxygen? Can we ring for help?
- Prompts:
  - Do not prompt students if they miss any aspect of the checklist below (ABCDE, SBAR) e.g. if they do not record the respiratory rate. These should be discussed/explored in the debrief. Please use the template to make notes to use in the debrief.
  - If the students are struggling use a “general prompt” e.g. is there anything else you wish to do?
- Give queues for:
  - Data that students cannot obtain from mannequin e.g. temperature, capillary refill etc.
  - Equipment drug location etc.
  - Mannequin functions e.g. pulse

Skills		Yes	No	Notes
Wash hands				
Introduces team/self to patient				
Patient assessment				
A	Assessment of Airway			
B	Assessment of Breathing			
	• Rate			
	• O <sub>2</sub> Saturations			
	• Attaches O2 mask			
C	Assessment of Circulation			
	• Pulse			
	• Manual BP			
	• Skin colour/Capillary refill			
	• Urine output			
D	Assesses disability			
	• Identifies agitation			
	• Blood sugar			
E	Assesses exposure			
	• Temperature			
	• Checks wound			
	• Checks drain			
Actions	Records EWS			
	Calls for help – (Senior colleague/doctor)			
SBAR handover	Situation			
	• Name and ward			
	• Name of patient			
	• Problem described			
	Background			
	• Reason for patient's admission			
	• Explain significant medical history			
	Assessment			
	• Vital signs			
	• Early warning score			
	Recommendations			
	• Explain what they need			
	• Identify what they would like to happen next			

**Simulation session aims:**

- Recognise the deteriorating patient
- Assess the patient utilising the “ABCDE” assessment framework and accurately record findings
- Report findings and hand over using “SBAR” tool.

**Scenario outline:**

- See asthma scenario guide

**Facilitator role:**

- Mentor

**Facilitation guidance:**

- Introduce students to mannequin and environment.
- “Hand over” scenario
- Respond to direct questions from students e.g. can we attach oxygen? Can we ring for help?
- Prompts:
  - Do not prompt students if they miss any aspect of the checklist below (ABCDE, SBAR) e.g. if they do not record the respiratory rate. These should be discussed/explored in the debrief. Please use the template to make notes to use in the debrief.
  - If the students are struggling use a “general prompt” e.g. is there anything else you wish to do?
- Give queues for:
  - Data that students cannot obtain from mannequin e.g. temperature, capillary refill etc.
  - Equipment drug location etc.
  - Mannequin functions e.g. pulse

Skills		Yes	No	Notes
Wash hands				
Introduces team/self to patient				
Patient assessment				
A	Assessment of Airway			
B	Assessment of Breathing			
	• Rate			
	• O <sub>2</sub> Saturations			
	• Attaches O2 mask			
C	Assessment of Circulation			
	• Pulse			
	• Manual BP			
	• Skin colour/Capillary refill			
	• Urine output			
D	Assesses disability			
	• Identifies agitation			
	• Blood sugar			
E	Assesses exposure			
	• Temperature			
	• Checks wound	N/A	N/A	
	• Checks drain	N/A	N/A	
Actions	Records EWS			
	Calls for help – (Senior colleague/doctor)			
SBAR handover	Situation			
	• Name and ward			
	• Name of patient			
	• Problem described			
	Background			
	• Reason for patient's admission			
	• Explain significant medical history			
	Assessment			
	• Vital signs			
	• Early warning score			
	Recommendations			
	• Explain what they need			
	• Identify what they would like to happen next			

**Simulation session aims:**

- Recognise the deteriorating patient
- Assess the patient utilising the “ABCDE” assessment framework and accurately record findings
- Report findings and hand over using “SBAR” tool.

**Scenario outline:**

- See chest pain scenario guide

**Facilitator role:**

- Mentor

**Facilitation guidance:**

- Introduce students to mannequin and environment.
- “Hand over” scenario
- Respond to direct questions from students e.g. can we attach oxygen? Can we ring for help?
- Prompts:
  - Do not prompt students if they miss any aspect of the checklist below (ABCDE, SBAR) e.g. if they do not record the respiratory rate. These should be discussed/explored in the debrief. Please use the template to make notes to use in the debrief.
  - If the students are struggling use a “general prompt” e.g. is there anything else you wish to do?
- Give queues for:
  - Data that students cannot obtain from mannequin e.g. temperature, capillary refill etc.
  - Equipment drug location etc.
  - Mannequin functions e.g. pulse



Skills		Yes	No	Notes
Wash hands				
Introduces team/self to patient				
Patient assessment				
A	Assessment of Airway			
B	Assessment of Breathing			
	• Rate			
	• O <sub>2</sub> Saturations			
	• Attaches O2 mask			
C	Assessment of Circulation			
	• Pulse			
	• Manual BP			
	• Skin colour/Capillary refill			
	• Urine output			
D	Assesses disability			
	• Identifies agitation			
	• Blood sugar			
E	Assesses exposure			
	• Temperature			
	• Checks wound	N/A	N/A	
	• Checks drain	N/A	N/A	
Actions	Records EWS			
	Calls for help – (Senior colleague/doctor)			
SBAR handover	Situation			
	• Name and ward			
	• Name of patient			
	• Problem described			
	Background			
	• Reason for patient's admission			
	• Explain significant medical history			
	Assessment			
	• Vital signs			
	• Early warning score			
	Recommendations			
	• Explain what they need			
	• Identify what they would like to happen next			

**Simulation session aims:**

- Recognise the deteriorating patient
- Assess the patient utilising the “ABCDE” assessment framework and accurately record findings
- Report findings and hand over using “SBAR” tool.

**Scenario outline:**

- See the sepsis scenario guide

**Facilitator role:**

- Mentor

**Facilitation guidance:**

- Introduce students to mannequin and environment.
- “Hand over” scenario
- Respond to direct questions from students e.g. can we attach oxygen? Can we ring for help?
- Prompts:
  - Do not prompt students if they miss any aspect of the checklist below (ABCDE, SBAR) e.g. if they do not record the respiratory rate. These should be discussed/explored in the debrief. Please use the template to make notes to use in the debrief.
  - If the students are struggling use a “general prompt” e.g. is there anything else you wish to do?
- Give queues for:
  - Data that students cannot obtain from mannequin e.g. temperature, capillary refill etc.
  - Equipment drug location etc.
  - Mannequin functions e.g. pulse

Skills		Yes	No	Notes
Wash hands				
Introduces team/self to patient				
Patient assessment				
A	Assessment of Airway			
B	Assessment of Breathing			
	• Rate			
	• O <sub>2</sub> Saturations			
	• Attaches O <sub>2</sub> mask			
C	Assessment of Circulation			
	• Pulse			
	• Manual BP			
	• Skin colour/Capillary refill			
	• Urine output			
D	Assesses disability			
	• Identifies agitation			
	• Blood sugar			
E	Assesses exposure			
	• Temperature			
	• Checks wound			
	• Checks drain			
Actions	Records EWS			
	Calls for help – (Senior colleague/doctor)			
SBAR handover	Situation			
	• Name and ward			
	• Name of patient			
	• Problem described			
	Background			
	• Reason for patient's admission			
	• Explain significant medical history			
	Assessment			
	• Vital signs			
	• Early warning score			
	Recommendations			
	• Explain what they need			
	• Identify what they would like to happen next			

**Simulation session aims:**

- Recognise the deteriorating patient
- Assess the patient utilising the “ABCDE” assessment framework, accurately record findings, and report findings using “SBAR” tool.

**Scenario outline: Key elements**

- See MI scenario guide
  - Part 1 Assessment - Students to:
    - Undertake initial “ABCDE” assessment.
    - Recognise deterioration and call for help using “SBAR” to handover.
  - Part 2 Arrest – Students to:
    - Commence CPR when patient arrests and follow BLS/ALS algorithm (2010 guidelines).

**Facilitator role:**

- Mentor

**Facilitation guidance:**

- Introduce students to mannequin and environment.
- “Hand over” scenario
- Respond to direct questions from students e.g. can we attach oxygen? Can we ring for help?
- Prompts:
  - Do not prompt students if they miss any aspect of the checklist below (ABCDE, SBAR) e.g. if they do not record the respiratory rate. These should be discussed/explored in the debrief. Please use the template to make notes to use in the debrief.
  - If the students are struggling use a “general prompt” e.g. is there anything else you wish to do?
- Give queues for:
  - Data that students cannot obtain from mannequin e.g. temperature, capillary refill etc.
  - Equipment drug location etc.
  - Mannequin functions e.g. pulse

## AA0504: Debrief checklist, chest pain/MI scenario (To support analysis phase of debriefing)

INITIAL ASSESSMENT - Skills		Yes	No	Notes
Wash hands				
Introduces team/self to patient				
Patient assessment				
A	Assessment of Airway			
B	Assessment of Breathing			
	• Rate			
	• O <sub>2</sub> Saturations			
	• Attaches O <sub>2</sub> mask			
C	Assessment of Circulation			
	• Pulse			
	• Manual BP			
	• Skin colour/Capillary refill			
	• Urine output			
D	Assesses disability			
	• Identifies agitation			
	• Blood sugar			
E	Assesses exposure			
	• Temperature			
	• Checks wound	N/A	N/A	
	• Checks drain	N/A	N/A	
Actions	Records EWS			
	Calls for help – (Senior colleague/doctor)			
SBAR handover	Situation			
	• Name and ward			
	• Name of patient			
	• Problem described			
	Background			
	• Reason for patient's admission			
	• Explain significant medical history			
	Assessment			
	• Vital signs			
	• Early warning score			
	Recommendations			
	• Explain what they need			
	• Identify what they would like to happen next			

**Simulation session aims:**

- Recognise the deteriorating patient
- Assess the patient utilising the “ABCDE” assessment framework, accurately record findings, and report findings using “SBAR” tool.

**Scenario outline:**

- See anaphylaxis scenario guide

**Facilitator role:**

- Mentor

**Facilitation guidance:**

- Introduce students to mannequin and environment.
- “Hand over” scenario
- Respond to direct questions from students e.g. can we attach oxygen? Can we ring for help?
- Prompts:
  - Do not prompt students if they miss any aspect of the checklist below (ABCDE, SBAR) e.g. if they do not record the respiratory rate. These should be discussed/explored in the debrief. Please use the template to make notes to use in the debrief.
  - If the students are struggling use a “general prompt” e.g. is there anything else you wish to do?
- Give queues for:
  - Data that students cannot obtain from mannequin e.g. temperature, capillary refill etc.
  - Equipment drug location etc.
  - Mannequin functions e.g. pulse

**AA0504: Debrief checklist, Anaphylaxis scenario** (To be used to support analysis phase of debriefing)

Initial phase – assessment - Skills		Yes	No	Notes
Wash hands				
Introduces team/self to patient				
Patient assessment				
A	Assessment of Airway			
B	Assessment of Breathing			
	• Rate			
	• O <sub>2</sub> Saturations			
	• Attaches O2 mask			
C	Assessment of Circulation			
	• Pulse			
	• Manual BP			
	• Skin colour/Capillary refill			
	• Urine output			
D	Assesses disability			
	• Identifies agitation			
	• Blood sugar			
E	Assesses exposure			
	• Temperature			
	• Checks wound	N/A	N/A	
	• Checks drain	N/A	N/A	
Actions	Records EWS			
	Calls for help – (Senior colleague/doctor)			
SBAR handover	Situation			
	• Name and ward			
	• Name of patient			
	• Problem described			
	Background			
	• Reason for patient's admission			
	• Explain significant medical history			
	Assessment			
	• Vital signs			
	• Early warning score			
	Recommendations			
	• Explain what they need			
	• Identify what they would like to happen next			

## **Appendix 6 - Performance tool development**



The first phase was to identify appropriate items to be included in the tool through a review of the relevant literature. This included relevant guidelines such as the “In Hospital Resuscitation” ([The Resuscitation Council \(UK\), 2015d](#)), “Advanced Life Support” guidelines ([The Resuscitation Council \(UK\), 2015b](#)) and recommendations for the management of deteriorating patients ([Odell, 2013](#); [Patient Safety First, 2008](#); [Smith et al., 2002](#); [The Resuscitation Council \(UK\), 2015a](#)). In the review of the broader literature, I found that a number of researchers ([Arnold et al., 2009](#); [Liaw et al., 2011](#); [Merriman et al., 2014](#); [Stayt et al., 2015](#)) had developed performance based assessment tools that were structured on the ABCDE and SBAR approaches. These had also been used to evaluate the performance of nurses in the management of a deteriorating patient. In a pilot study Arnold et al. (2009) developed an eleven item “Emergency Response Performance Tool” (ERPT) to evaluate the performance of registered nurses during an emergency cardiac arrest situation. Their study aimed at testing the validity and reliability of the ERPT instrument. The researchers enrolled twelve qualified nurses into the study and found that the results supported the reliability and validity of the ERPT instrument and, therefore, the inclusion of the ABCDE approach within the tool. The ERPT instrument was, however, unsuitable for the use in my study since it was developed for qualified nurses and, as a result, many of the items were beyond the scope of the participants and above their current level of competence.

[Merriman et al. \(2014\)](#) undertook a randomised controlled trial to determine whether SBE was more effective than traditional classroom based education in the development of assessment skills by nursing students (N=50) to recognise a deteriorating patient. To do so, they developed an objective structured clinical examination (OSCE) performance tool that was based on the ABCDE assessment

process. They used a pre-post design and randomly assigned students to either the control group (Classroom based teaching) or, the experimental group (SBE teaching). The students in the experimental group displayed a significantly better performance (Mean score of 19 with a standard deviation of  $\pm 3.2$ ) on the post intervention OSCE than the control group (Mean score of 16 with a standard deviation of  $\pm 3.7$ ). They also found that the students who received SBE teaching were significantly more satisfied with their teaching experience. They concluded that SBE was a more effective teaching strategy than the traditional approach. However, in terms of the OSCE performance tool, Merriman et al. (2014) did not discuss its development or provide any validity or reliability data on its use, therefore, raising questions over the validity of their findings.

In a repeat of this study, Stayt et al. (2015) adopted the same methodology but used ninety-eight first year nursing students from across two sites. Once again, the intervention group performed significantly better in their post OSCEs (Range being 11.5-24.0 and mean of 18 [SD 3.2]) than the control group (Range being 7.0-21.5 and a mean of 13.2 [SD 4.8]). The same data collection instruments were used but this time, the researchers briefly reported on the validity of the OSCE performance tool, stating that it had been subject to continual review and modification by university educators and clinical peers. They also reported that it had a reliability coefficient of 0.91, which they established during a pilot study. This review was somewhat sparse and lacked rigour, therefore, making interpretation of the results difficult and, once again, leaving a question mark over the reliability and validity of the OSCE checklist.

[Liaw et al. \(2011\)](#) developed a tool, entitled the “Rescuing a Patient in Deteriorating Situations” (RAPIDS) tool, for assessing the performance of student nurses from Singapore. They used a three-phase approach to evaluate the validity and reliability of their forty-two item tool. In phase one, they developed the tool following a literature review and consensus panel discussion with national experts. In phase two, they established the content validity through a further review by an international panel of experts. The international panel of experts were asked to rank each of the RAPIDS-Tools items on a four-point scale (1 = not relevant, to 4 = very relevant) according to its relevance to assessing a deteriorating patient. This was then analysed using the item-level content validity index (I-CVI) and items were removed if they did not score greater than 0.78 on the I-CVI index ([Polit and Beck, 2006](#)).

In phase three, the authors used a convenience sample of thirty (fifteen second and fifteen third year) students to test the psychometric properties of the RAPIDS-Tool. They used three independent raters to assess the students’ performances and, following a *t*-test analysis, concluded that the tool had an adequate construct validity. They found that the mean total scores were significantly higher for the year three students (Mean = 31.42, SD = 4.06) ( $t = 15.48$ ,  $p < 0.001$ ) than those of the year two students (Mean = 11.36, SD = 2.95). In terms of inter-rater reliability, they found that the tool had a high ICC of 0.99 (95% confidence interval, 0.98–0.99) and, concluded that the tool was useful for both formative and summative evaluations. However, due to the time constraints, on both faculty and students, they acknowledged, that they could only use a single scenario with several deteriorating conditions built within it and, as a result, recommended that future studies should use multiple case scenarios with a boarder scope of conditions to provide more valid psychometric testing.

Despite this, Liaw et al. (2011) demonstrated that the RAPIDS-Tool was both a valid and reliable tool for evaluating the performance of student nurses and, as it had a greater focus on the deteriorating patient and used a performance-based criteria approach (Fastre et al., 2010) it appeared to be a much more appropriate tool to use to evaluate the participant's performance in my study. Unfortunately, Liaw et al. (2011) developed it to evaluate the performance of students across a whole nursing programme and, as discussed, the performance tool in my study was not aimed at providing a generic evaluation but it was aimed at solely measuring the performance of adult nursing students in year two of their programme. This, once again, brought into question the appropriateness of the tool to evaluate the performance of my participants. I concluded, as a result, that the most appropriate route for me to take was to develop a performance-based checklist tool that focused on evaluating the participants in my study. That was aimed at assessing their overall performance, as a team, using a numerical score that was coded to identify whether they had undertaken a representative task fully (Yes - 2), partially completed (Yes – 1) or not completed/undertaken (No - 0). As each team received a score of between 0 – 50, the level of measurement was categorised as a continuous variable and, in particular a ratio variable (Field, 2013, p. 10; Prion and Adamson, 2013; Walters and Freeman, 2010, p. 437).

As I was able to pre-programme the patient simulators; for example, low blood pressure or a high respiratory rate, these pre-set values were recorded and compared to the results obtained by the participants. This enabled the accuracy of the participant's recordings to be compared to the pre-set values and, as a result, gauge their contribution to the overall quality of the team performance (Nadler et al.,

2011). I utilised three parameters to assess the accuracy of the recordings: the patient simulator's respiratory rate, heart rate and blood pressure. At this stage, the limits for each parameter were provisionally set: the respiratory rate ( $\pm 2$  Breaths/minute), heart rate ( $\pm 2$  Beats/minute), and blood pressure ( $\pm 5$  mmHg for both the systolic and diastolic). These were numerically coded to ascertain whether the participants' recordings were accurate and within the range (Yes -1) or, if they were not, outside the range (No - 0). This gave a range of scores between 0 – 53.

In the second stage of validity testing, I aimed to establish, through an expert panel review, the appropriateness of the items to be included ([Polit and Beck, 2006](#)). The first panel consisted of members of the adult nursing department (N=6), who had expertise in both SBE and acute care and, who were experienced in delivering the SBE scenarios at this level. The panel recommended that two further items needed to be added to ensure that the performance tool captured all aspects of the scenarios. These were checking the patients wound and wound drains, together with the identification of agitation. This resulted in a twenty-six item checklist that had a range of scores between 0 – 55. At this point, a great deal of discussion ensued regarding the level of performance the tool evaluated. Within the review panel one school of thought was to set the level of assessment at the point of qualification as this would be in line with the standards for pre-registration nursing education set for a newly qualified nurse ([NMC 2010](#)). This meant that the participants during the actual scenario would be able to apply oxygen following the prescription chart and not rely on their “mentor” to administer it. The second school of thought highlighted that this approach was not in line with the DP framework, which outlined that tasks should be set at the participant's current level of performance ([Ericsson, 2004](#); [Ericsson, 2015](#)). It was also not in line with a number of key education philosophies such as Vygotsky's zones of proximal development ([1978](#)) and the cognitive load theory ([van](#)

[Merrienboer and Sweller, 2010](#)). The former was utilised to ensure that the participants were supported during the scenario and that their learning was scaffolded ([Wood et al., 1976](#)) to ensure that they developed within their zone of proximal development and were not pushed beyond their outer frame of “Knowledge in waiting” ([Vygotsky and Cole, 1978](#)). As a result, it was felt that if the level was set too high this would hinder the ability of the participants to learn.

The discussions, in particular, centred around cognitive load theory ([van Merrienboer and Sweller, 2010](#)). In line with this theory, it was argued that the complexity of the SBE scenarios should be reduced so that intrinsic load was optimised and extraneous load minimised. In doing so, the participants would be able to develop schema that facilitated germane load and, subsequently, learning. Following these discussions, the review panel agreed to set the checklist items at the participant’s current level of performance and, so in the oxygen example, the item was set at recognising the need for oxygen. Another point raised by the review panel was whether an item on the checklist could be partially completed. The argument was put forward that a task could either be undertaken correctly or not at all and, following a debate, a consensus was reached and it was agreed to remove this code from the checklist. The numerical coding was amended accordingly to include undertaken (Yes -2) or not undertaken (No - 0), which gave a range of scores between 0 – 55. At this stage, the review panel also agreed the limits for the accuracy for the respiratory rate, heart rate and blood pressure parameters.

Once the checklist items had been agreed, a further review, phase three, was undertaken with colleagues from outside the Department (N=6) who were

independent of the first panel. This second panel comprised of colleagues who had expertise in both SBE and critical care who were from across the university (n=4) or external to the University and based in clinical practice (n=2). They included colleagues from the undergraduate (n=2) and post-graduate (n=2) programmes of another department and, externally from clinical practice (n=2). The latter also included a medical consultant based in Critical Care. This panel were used to rate each scale item in terms of its relevance to the underlying concept, the recognition of the deteriorating patient. Liaw et al. (2011) and Todd et al. (2008b) both successfully used a four point Likert scale to assess the content validity of their performance rating scales. Therefore, I adopted this four point Likert scale that comprised point 1 (Not relevant), 2 (Somewhat relevant), 3 (Quite relevant) to 4 (Highly relevant). As identified by Polit and Beck (2006) the I-CVI tool guides researchers in revising, deleting, or substituting items and was subsequently adopted. The I-CVI tool score was calculated by adding together the number of experts giving a rating of either 3 or 4 for each item and then dividing this by the total number of experts ([Polit and Beck, 2006](#)). All items were found to have full rater consensus regarding their relevance to the checklist (I-CVI = 1.00), except for two. These were the checking of the patient's drains in E – exposure, and the identification of agitation in D - disability. One rater felt that these two items were not relevant, and when they were removed, the I-CVI fell to 0.83 but with an overall S – CVI rating of 0.98. This was, however, over the 0.90 recommended by Polit and Beck (2006).

Although the overall score was above 0.90, the results were fed back to the departmental panel for further discussion and, on review, they felt that the checking drains in E – exposure needed to be amended to include not applicable for those scenarios that did not contain a surgical wound. In relation to the identification of

agitation under D for disability, the external review panel commented that this should be replaced by a conscious level scale such as “AVPU” (**A**lert, responds to **V**oice, responds to **P**ain and **U**nresponsive) ([The Resuscitation Council \(UK\), 2015a](#)). However, when this was presented to the departmental panel they argued that although the students were taught to use the AVPU score, agitation was in fact an early sign that could herald a change in a patient’s condition ([Clark and Kumar, 2012, p. 881](#); [Porth, 2005, p. 621](#)). As early signs were often missed ([The National Institute for Health and Clinical Excellence, 2007](#); [The National Patient Safety Agency, 2007](#)) the panel felt that it was important that this item should be kept in the performance tool. To guarantee consistency, I ensured that during training, future raters were made explicitly aware of this element and the rationale for its inclusion.

Since it was also imperative to test the reliability of the tool, I tested it for inter-rater reliability ([Griffiths and Rafferty, 2010, p. 416](#)). A series of twelve videos captured during the pilot stage were randomly selected from the four GT groups used. These were reviewed by three raters and myself (N = 4). Once again, the raters had extensive experience in SBE and managing critically ill patients. The data collected was analysed using SPSS® (IBM® SPSS® Statistics version 22) for inter-rater reliability using ICC ([Downing, 2004](#); [Field, 2013, p. 712](#)). Using the ICC method, a Cronbach’s  $\alpha$  of 0.86 (95% confidence interval: 0.83 – 0.88) was found and, as this was above the value of 0.70 recommended by Downing (2004) the tool was deemed to be reliable and was finalised (Appendix 7).



## **Appendix 7 - Performance tools**

# Simulation performance observation tool (Hypovolaemia)

## Deliberate practice study

Please tick					
GT Identifier		Group Identifier		Participant Number	
Red		A		1	5
Blue		B		2	6
Green		C		3	7
Orange		D		4	8

Please tick		
1 <sup>st</sup> simulation	2 <sup>nd</sup> simulation	
Date		
Start time	Finish time	Total

Skills		Yes (1)	No (0)	Set values	Participant values	Accuracy score	Notes
Wash hands							
Introduces team/self to patient							
Patient assessment							
A	Assessment of Airway						
B	Assessment of Breathing						
	• Rate			28 BPM			
	• O <sub>2</sub> Saturations			96%			
	• Attaches O <sub>2</sub> mask						
C	Assessment of Circulation						
	• Pulse			110 BPM			
	• Manual BP			120/70 mmHg			
	• Skin colour/Capillary refill						
	• Urine output			Less than 30 mls/hr			
D	Assesses disability						
	• Identifies agitation						
	• Blood sugar						
E	Assesses exposure						
	• Temperature						
	• Checks wound						
	• Checks drain						
Actions	Records EWS						
	Calls for help – (Senior colleague/doctor)						
SBAR handover	Situation						
	• Name and ward						
	• Name of patient						
	• Problem described						
	Background						
	• Reason for patient's admission						
	• Explain significant medical history						
	Assessment						
	• Vital signs						
	• Early warning score						
	Recommendations						
	• Explain what they need						
	• Identify what they would like to happen next						
Total							
Overall total							

# Simulation performance observation tool (Asthma)

## Deliberate practice study

Please tick						
GT Identifier	Group Identifier		Participant Number			
Red		A		1		5
Blue		B		2		6
Green		C		3		7
Orange		D		4		8

Please tick		
1 <sup>st</sup> simulation	2 <sup>nd</sup> simulation	
Date		
Start time	Finish time	Total

Skills		Yes (1)	No (0)	Set values	Participant values	Accuracy score	Notes
Wash hands							
Introduces team/self to patient							
Patient assessment							
A	Assessment of Airway						
B	Assessment of Breathing						
	• Rate			28 BPM			
	• O <sub>2</sub> Saturations			88%			
	• Attaches O2 mask						
C	Assessment of Circulation						
	• Pulse			110 BPM			
	• Manual BP			145/100 mmHg			
	• Skin colour/Capillary refill						
	• Urine output			Not passed urine			
D	Assesses disability						
	• Identifies agitation						
	• Blood sugar						
E	Assesses exposure						
	• Temperature						
	• Checks wound	N/A	N/A				
	• Checks drain	N/A	N/A				
Actions	Records EWS						
	Calls for help – (Senior colleague/doctor)						
SBAR handover	Situation						
	• Name and ward						
	• Name of patient						
	• Problem described						
	Background						
	• Reason for patient's admission						
	• Explain significant medical history						
	Assessment						
	• Vital signs						
	• Early warning score						
	Recommendations						
	• Explain what they need						
	• Identify what they would like to happen next						
Total							
Overall total							

## Simulation performance observation tool (Chest pain)

## Deliberate practice study

Please tick						
GT Identifier		Group Identifier		Participant Number		
Red		A		1	5	
Blue		B		2	6	
Green		C		3	7	
Orange		D		4	8	

Please tick		
1 <sup>st</sup> simulation	2 <sup>nd</sup> simulation	
Date		
Start time	Finish time	Total

Skills		Yes (1)	No (0)	Set values	Participant values	Accuracy score	Notes
Wash hands							
Introduces team/self to patient							
Patient assessment							
A	Assessment of Airway						
B	Assessment of Breathing						
	• Rate			28 BPM			
	• O <sub>2</sub> Saturations			93%			
	• Attaches O <sub>2</sub> mask						
C	Assessment of Circulation						
	• Pulse			112 BPM			
	• Manual BP			160/105 mmHg			
	• Skin colour/Capillary refill						
	• Urine output			Not passed urine			
D	Assesses disability						
	• Identifies agitation						
	• Blood sugar						
E	Assesses exposure						
	• Temperature						
	• Checks wound						
	• Checks drain						
Actions	Records EWS						
	Calls for help – (Senior colleague/doctor)						
SBAR handover	Situation						
	• Name and ward						
	• Name of patient						
	• Problem described						
	Background						
	• Reason for patient's admission						
	• Explain significant medical history						
	Assessment						
	• Vital signs						
	• Early warning score						
	Recommendations						
	• Explain what they need						
	• Identify what they would like to happen next						
Total							
Overall total							

## Simulation performance observation tool (Sepsis)

## Deliberate practice study

Please tick						
GT Identifier	Group Identifier		Participant Number			
Red		A		1	5	
Blue		B		2	6	
Green		C		3	7	
Orange		D		4	8	

Please tick		
1 <sup>st</sup> simulation	2 <sup>nd</sup> simulation	
Date		
Start time	Finish time	Total

Skills		Yes (1)	No (0)	Set values	Participant values	Accuracy score	Notes
Wash hands							
Introduces team/self to patient							
Patient assessment							
A	Assessment of Airway						
B	Assessment of Breathing						
	• Rate			26 BPM			
	• O <sub>2</sub> Saturations			96%			
	• Attaches O <sub>2</sub> mask						
C	Assessment of Circulation						
	• Pulse			100 BPM			
	• Manual BP			112/46 mmHg			
	• Skin colour/Capillary refill						
	• Urine output			Not passed urine			
D	Assesses disability						
	• Identifies agitation						
	• Blood sugar						
E	Assesses exposure						
	• Temperature						
	• Checks wound	N/A	N/A				
	• Checks drain	N/A	N/A				
Actions	Records EWS						
	Calls for help – (Senior colleague/doctor)						
SBAR handover	Situation						
	• Name and ward						
	• Name of patient						
	• Problem described						
	Background						
	• Reason for patient's admission						
	• Explain significant medical history						
	Assessment						
	• Vital signs						
	• Early warning score						
	Recommendations						
	• Explain what they need						
	• Identify what they would like to happen next						
Total							
Overall total							

# Simulation performance observation tool (MI)

## Deliberate practice study

Please tick					
GT Identifier		Group Identifier		Participant Number	
Red		A		1	5
Blue		B		2	6
Green		C		3	7
Orange		D		4	8

Please tick		
1 <sup>st</sup> simulation	2 <sup>nd</sup> simulation	
Date		
Start time	Finish time	Total

Skills		Yes (1)	No (0)	Set values	Participant values	Accuracy score	Notes
Wash hands							
Introduces team/self to patient							
Patient assessment							
A	Assessment of Airway						
B	Assessment of Breathing						
	• Rate			28 BPM			
	• O <sub>2</sub> Saturations			93%			
	• Attaches O <sub>2</sub> mask						
C	Assessment of Circulation						
	• Pulse			112 BPM			
	• Manual BP			160/105 mmHg			
	• Skin colour/Capillary refill						
	• Urine output			Not passed urine			
D	Assesses disability						
	• Identifies agitation						
	• Blood sugar						
E	Assesses exposure						
	• Temperature						
	• Checks wound						
	• Checks drain						
Actions	Records EWS						
	Calls for help – (Senior colleague/doctor)						
SBAR handover	Situation						
	• Name and ward						
	• Name of patient						
	• Problem described						
	Background						
	• Reason for patient's admission						
	• Explain significant medical history						
	Assessment						
	• Vital signs						
	• Early warning score						
	Recommendations						
	• Explain what they need						
	• Identify what they would like to happen next						
CPR	Commences BLS						
Total							
Overall total							

## Simulation performance observation tool (Anaphylaxis)

## Deliberate practice study

Please tick					
GT Identifier		Group Identifier		Participant Number	
Red		A		1	5
Blue		B		2	6
Green		C		3	7
Orange		D		4	8

Please tick		
1 <sup>st</sup> simulation	2 <sup>nd</sup> simulation	
Date		
Start time	Finish time	Total

Skills		Yes (1)	No (0)	Set values	Participant values	Accuracy score	Notes
Wash hands							
Introduces team/self to patient							
Patient assessment							
A	Assessment of Airway						
B	Assessment of Breathing						
	• Rate			28 BPM			
	• O <sub>2</sub> Saturations			90%			
	• Attaches O2 mask						
C	Assessment of Circulation						
	• Pulse			120 BPM			
	• Manual BP			90/40 mmHg			
	• Skin colour/Capillary refill						
	• Urine output			Not passed urine			
D	Assesses disability						
	• Identifies agitation						
	• Blood sugar						
E	Assesses exposure						
	• Temperature						
	• Checks wound	N/A	N/A				
	• Checks drain	N/A	N/A				
Actions	Records EWS						
	Calls for help – (Senior colleague/doctor)						
SBAR handover	Situation						
	• Name and ward						
	• Name of patient						
	• Problem described						
	Background						
	• Reason for patient's admission						
	• Explain significant medical history						
	Assessment						
	• Vital signs						
	• Early warning score						
	Recommendations						
	• Explain what they need						
	• Identify what they would like to happen next						
Total							
Overall total							

## **Appendix 8 - Self-efficacy tool**



Please tick						
GT Identifier	Group Identifier		Participant Number			
Red		A		1	5	
Blue		B		2	6	
Green		C		3	7	
Orange		D		4	8	

Please tick	
Pre simulation	Post simulation
Scenario	
Anaphylaxis	
Chest pain	

As part of the research project please complete the questions below. Please tick the box that applies.

1. I am confident that I can identify a deteriorating patient

strongly disagree		disagree		undecided		agree		strongly agree	
-------------------	--	----------	--	-----------	--	-------	--	----------------	--

2. I am confident using the ABCDE approach to assessing a patient

strongly disagree		disagree		undecided		agree		strongly agree	
-------------------	--	----------	--	-----------	--	-------	--	----------------	--

3. I do not feel confident handing over to a senior colleague using the SBAR framework

strongly disagree		disagree		undecided		agree		strongly agree	
-------------------	--	----------	--	-----------	--	-------	--	----------------	--

4. I feel confident In recording a manual blood pressure

strongly disagree		disagree		undecided		agree		strongly agree	
-------------------	--	----------	--	-----------	--	-------	--	----------------	--

5. I feel confident in recording vital observations (E.g. pulse, respiratory rate and temperature)

strongly disagree		disagree		undecided		agree		strongly agree	
-------------------	--	----------	--	-----------	--	-------	--	----------------	--

6. I do not feel confident working as a team

strongly disagree		disagree		undecided		agree		strongly agree	
-------------------	--	----------	--	-----------	--	-------	--	----------------	--

7. I feel confident in identifying the early warning signs of deterioration

strongly disagree		disagree		undecided		agree		strongly agree	
-------------------	--	----------	--	-----------	--	-------	--	----------------	--

## **Appendix 9 - Knowledge questionnaire**

Please tick						
GT Identifier	Group Identifier		Participant Number			
Red		A		1	5	
Blue		B		2	6	
Green		C		3	7	
Orange		D		4	8	

Please tick	
Pre simulation	Post simulation
Scenario	
Anaphylaxis	
Chest pain	

1. In shock (E.g. hypovolaemic shock) give **1 reason** why the skin looks pale and feels cold?

Answer:

2. In the SBAR framework **S** means:

- a) Stage ☐
- b) Simple ☐
- c) Situation ☐
- d) Severity ☐

3. In a patient who is deteriorating which of the following statements is true regarding their blood pressure?

- a) Hypotension is the first indication that a patient has deteriorated ☐
- b) Hypotension is a late indication that a patient has deteriorated ☐
- c) When a patient has deteriorated they become hypertensive ☐
- d) When a patient deteriorates their blood pressure remains constant ☐

4. Agitation/confusion can be an early sign of patient deterioration **identify 1 reason** why?

Answer:

5. ABCDE is an acronym for:

- a) Airway, breathing, circulation, diagnosis and essentials ☐
- b) Alert, breathing, circulation, diagnosis and essentials ☐
- c) Airway, breathing, circulation, disability and exposure ☐
- d) Alert, breathing, circulation, dysfunction and exposure ☐

6. In relation to a deteriorating patient which of the following statements is true regarding their breathing?
- a) A rise in the patient's respiratory rate is an early first indication that a patient has deteriorated ☐
  - a) Tachypnoea means deep breathing ☐
  - b) Tachypnoea is a late indication that a patient is deteriorating ☐
  - c) A rise in the patient's respiratory rate is a late indication that they are deteriorating ☐
7. EWS means:
- b) Early warning signs ☐
  - c) Early warning score ☐
  - d) Early warning symptoms ☐
  - e) Early warning stages ☐
8. A post-operative patient's vital observations on return from theatre were HR 70 beats/min, BP 120/85, RR 16 breaths/min, temp 36.8°C and SpO<sub>2</sub> 97%. You record them again after half an hour, which of the following would concern you?
- a) HR 78 beats/min, BP 128/80, RR 18 breaths/min, temp 36.8°C and SpO<sub>2</sub> 96%. ☐
  - b) HR 110 beats/min, BP 90/75, RR 24 breaths/min, temp 36.8°C and SpO<sub>2</sub> poor signal. ☐
  - c) HR 62 beats/min, BP 110/80, RR 14 breaths/min, temp 36.8°C and SpO<sub>2</sub> 98%. ☐
  - d) None of the above ☐
9. Capillary refill should normally be?
- a) Greater than 10 seconds ☐
  - b) Greater than 5 seconds ☐
  - c) Less than 2 seconds ☐
  - d) 0 seconds ☐
10. You record a patient's urine volume two hours after they returned from theatre and measure 24 mls/hr and it has been 60 mls/hr. There other observations are HR 110 beats/min, BP 90/75, RR 24 breaths/min, temp 36.8°C and SpO<sub>2</sub> poor signal. Give **1 reason** why the urine output has dropped?

Answer:

## **Appendix 10 - Participant invitation letter**

Dear .....

## INVITATION TO PARTICIPATE IN RESEARCH STUDY

The aim of this project is to investigate the effect of debriefing with team deliberate practice within a structured simulation programme on the performance, self-efficacy and knowledge of adult student nurses. You are invited to participate in this study.

Before you decide you need to understand why the research is being done and what it would involve from you.

The research is not directly funded by Northumbria University but is being conducted by Alan Platt who is an employee of Northumbria University as part of his doctorate studies.

You have been asked to take part in this study because you are a student nurse undertaking the adult pre-registration health programme.

An information sheet is enclosed which details the research and what you will be required to do if you agree to take part. Please read this carefully.

In 2-3 days time Alan Platt (The researcher) will contact you either by telephone call or via e-mail to find out if you are interested in taking part in this research. If you are, Alan will make arrangements to meet with you to provide further information and to answer any questions you may have.

You will then be offered a few days to consider whether you wish to be involved. If you do get involved all of the information collected from you will be held in the strictest confidence. In addition, you will be free to withdraw from the study at any time without this affecting you in any way.

Thank you for taking the time to consider being involved in this study

Yours faithfully,

Alan Platt  
Senior lecturer  
Principle Researcher

## **Appendix 11 - Consent and demographic data forms**

## CONSENT FORM

An investigation into the effect of debriefing with team deliberate practice within a structured simulation programme on the performance, self-efficacy and knowledge of adult student nurses.

	YES	Please initial the box NO
I confirm that I have read and understand the information sheet dated ..... for the above study	<input type="checkbox"/>	<input type="checkbox"/>
I have had the chance to ask questions about the study and these have been answered to my satisfaction	<input type="checkbox"/>	<input type="checkbox"/>
I am willing to be videoed as part of the study	<input type="checkbox"/>	<input type="checkbox"/>
I am willing to undertake an MCQ and questionnaire as part of the study	<input type="checkbox"/>	<input type="checkbox"/>
I am willing to allow the researcher to observe my practice	<input type="checkbox"/>	<input type="checkbox"/>
I understand that I can withdraw at any time if I change my mind and this will not affect me in any way	<input type="checkbox"/>	<input type="checkbox"/>
I know that my name and details will be kept confidential and will not appear in any printed documents	<input type="checkbox"/>	<input type="checkbox"/>

Please tick					
GT Identifier	Group Identifier	Participant Number			
Red	A	1	5		
Blue	B	2	6		
Green	C	3	7		
Orange	D	4	8		

I ..... [name of participant] understand the information presented to me by ..... [name of researcher] and agree to take part in the research

Signature ..... [Participant]

Date .....



As part of the research project please complete the questions below. Please tick the box that applies.

1. Group

GT Identifier	Group Identifier	Participant Number			
Red	A	1		5	
Blue	B	2		6	
Green	C	3		7	
Orange	D	4		8	

2. Gender

Male		Female	
------	--	--------	--

3. Age (Years)

18 - 24		25 - 30		31 - 36		37 - 42		43>	
---------	--	---------	--	---------	--	---------	--	-----	--

4. Base hospital

Please specify
----------------

5. Have you had previous healthcare experience?

YES NO (Please circle)

If yes please outline what experience in the box provided
---

## **Appendix 12 - Study information sheet**

## Research Study Information Sheet

### **“An investigation into the effect of debriefing with team deliberate practice within a structured simulation programme on the performance, self-efficacy and knowledge of adult student nurses”**

I am inviting you to take part in a research study. Before you decide please read the following information carefully. Talk to others about the study if you wish. Please ask if there is anything that is not clear or if you would like more information.

#### **What is the purpose of the study?**

The aim of this project is to investigate the effect of debriefing with team deliberate practice within a structured simulation programme on the performance, self-efficacy and knowledge of adult student nurses.

#### **Why have I been asked to take part in this study?**

You have been asked to take part in this study because you are a student nurse undertaking the adult pre-registration health programme.

#### **Do I have to take part in the study?**

No, it is up to you to decide if you wish to take part. Alan Platt will meet with you to discuss the study in more detail. You will also have an opportunity ask any questions you may have.

If you agree to take part then Alan Platt will ask you to sign a consent form to show that you have agreed to take part. You are free to withdraw from the study at anytime, without giving a reason. Withdrawal will not affect you in any way and your decision to withdraw will not be shared with anyone.

#### **What am I being asked to do?**

If you decide to take part in this study you will:

- Be asked to participate in a simulation event that includes a pre-brief, scenario, debrief and may or may not include a debriefing with team deliberate practice component

- Be asked to complete a pre and post multiple choice questionnaire (MCQ) and self efficacy questionnaire
- Be asked to complete a pre and post questionnaire

Irrespective of whether you take part or not you will be expected to undertake a simulation exercise and receive feedback using video analysis as part of your educational programme.

**Are there any disadvantages to taking part?**

There are unlikely to be any disadvantages or risks in taking part, however, if you are upset in any way, the researcher will stop the simulation.

**What are the benefits of taking part?**

We cannot promise the study will help you but the information we get from this study will help us understand how deliberate practice and simulation can contribute to the educational development of future students. Any complaint about the way you have been dealt with during the study or any possible harm you might suffer will be addressed.

**CONFIDENTIALITY**

**Collecting the data**

The data for this study will be collected using the audio visual system in the clinical skills centre, and also on observational charts both MCQ and questionnaire sheets. The data will not contain your name etc. and any paper based record will be securely stored.

**Storage of the interview tapes, transcripts and other papers**

The video recordings and any paper based data will be kept in a locked cupboard at Northumbria University until the research is completed. Once the study ends the video tapes will be wiped. The paper copies of data will also be stored securely in a locked cupboard at the University. These documents are anonymised and are marked by a unique identifier (allocated to you by Alan Platt).

The only individuals who will have access to the video tapes and papers are the research team

Any information which is produced as part of the dissemination activities associated with the project will not bear your name.

**What will happen to the results of the research study?**

A report will be produced for the School and disseminated by Alan Platt, which will be made available to study participants. This will present the anonymised data from the study. The results will also be shared with academics in other Universities through conference presentations and publications in professional journals.

**Who is funding this study?**

Northumbria University are supporting this study through its programme of staff scholarly activity

**Who has reviewed this study?**

The proposed research has been reviewed by the School Research Committee and the NHS Research Ethics Committee (REC) and also the NHS Trust Research and Development department where applicable.

**Where can I find further information about the research?**

In the first instance please contact Alan Platt:

Mr Alan Platt– Principal Investigator (0191) 215 6677

If you are unhappy about this study please contact

Dr Linda Prescott-Clements PhD Supervisor (0191) 2156070

**If I take part can I withdraw from the study at a later date?**

You can withdraw from the study at any time. Simply contact Alan Platt to tell me you would like to withdraw. My details are at the end of this information sheet.

When you indicate your intention to withdraw from this study Alan Platt will ask you if you would like him to destroy all of the data collected to the point of withdraw or whether we can continue to use it in an anonymised form.

**Complaints**

If you have concerns about any aspect of this study please speak to either Alan Platt, or PhD Supervisor (details below) and we will do our best to address these. If you remain unhappy you may wish to contact the sponsor of this research who is Dr Linda Prescott-Clements PhD Supervisor (0191) 2156070, e-mail [linda.prescott-clements@northumbria.ac.uk](mailto:linda.prescott-clements@northumbria.ac.uk)

**Information disclosure**

Alan Platt is a Register Nurse and is governed by the Nursing and Midwifery Council (NMC), he will inform you at the initial meeting of the NMC code (2008), and also the NMC raising and escalating concerns regulations (2010)

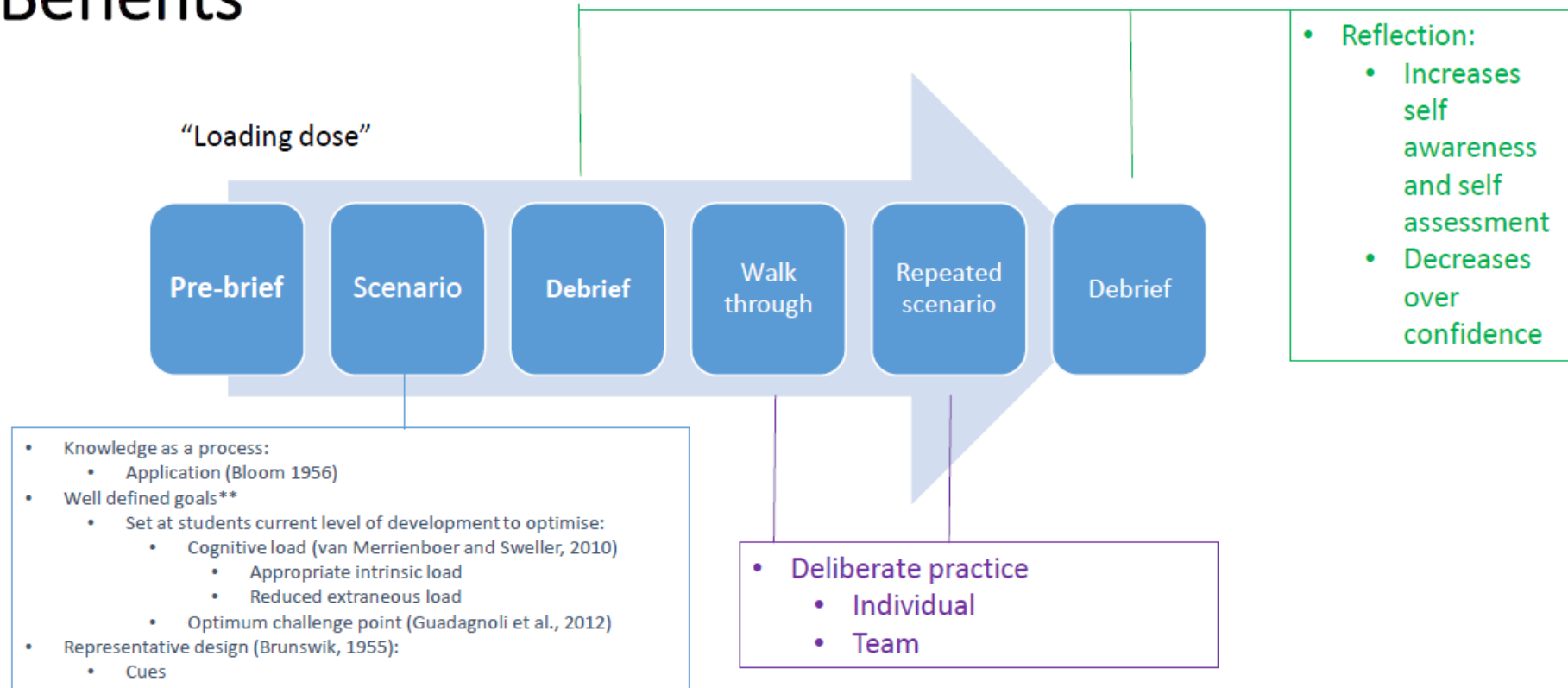
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## **Appendix 13 - Simulation with team deliberate practice: Benefits**

# Simulation with Team Deliberate Practice – Benefits



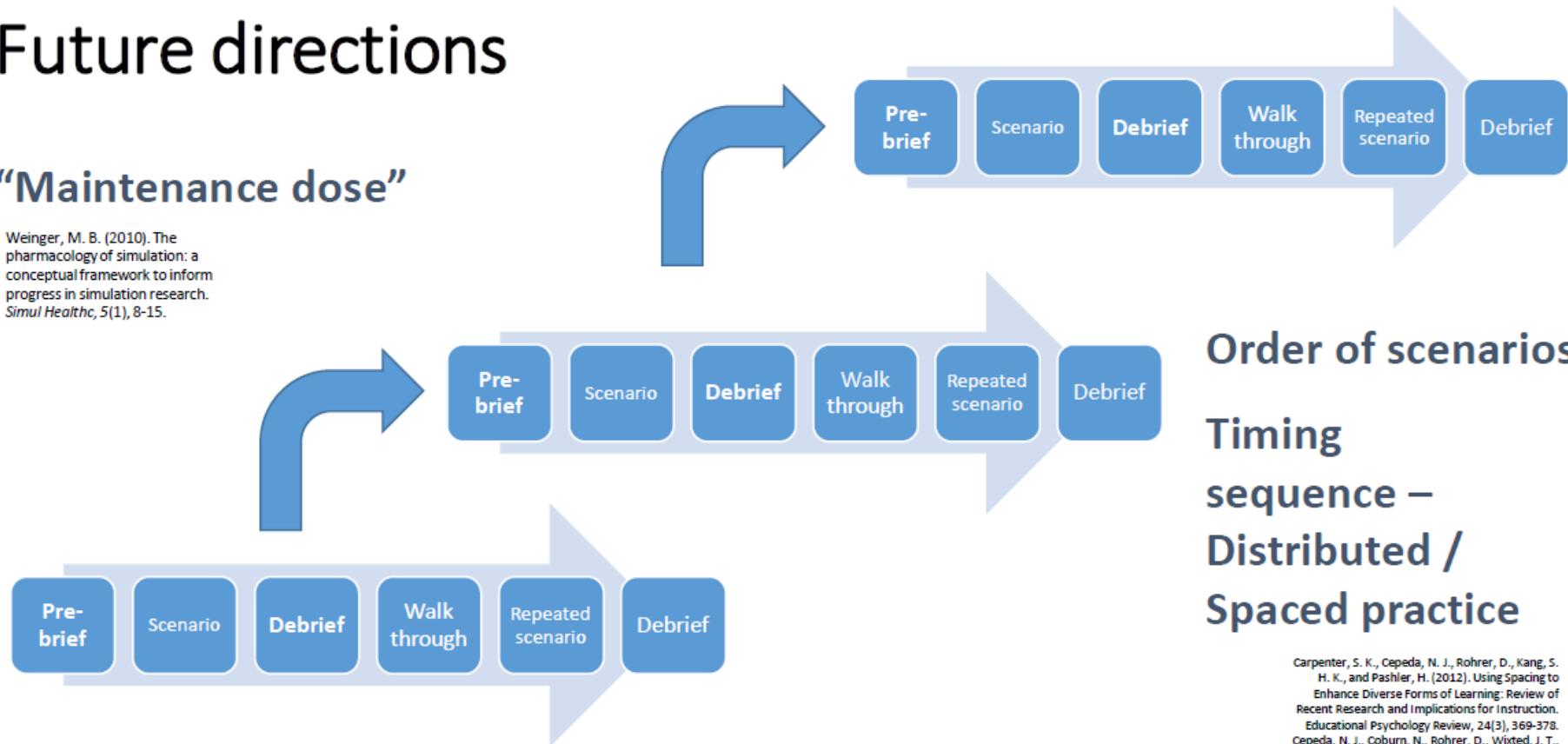
## **Appendix 14 - Simulation with deliberate practice: Future directions**



# Simulation with Team Deliberate Practice – Future directions

## “Maintenance dose”

Weinger, M. B. (2010). The pharmacology of simulation: a conceptual framework to inform progress in simulation research. *Simul Healthc*, 5(1), 8-15.

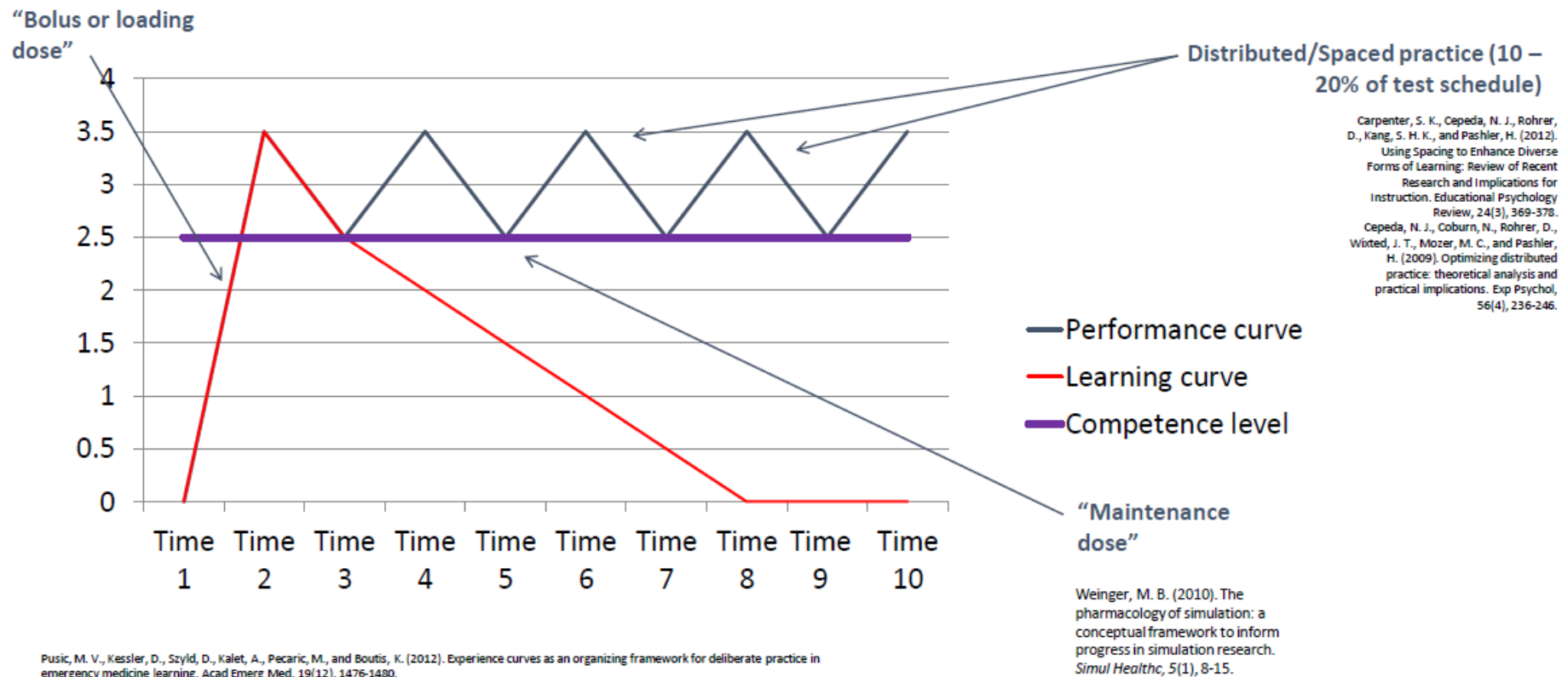


Order of scenarios:

Timing  
sequence –  
Distributed /  
Spaced practice

Carpenter, S. K., Cepeda, N. J., Rohrer, D., Kang, S. H. K., and Pashler, H. (2012). Using Spacing to Enhance Diverse Forms of Learning: Review of Recent Research and Implications for Instruction. *Educational Psychology Review*, 24(3), 369-378.  
Cepeda, N. J., Coburn, N., Rohrer, D., Wixted, J. T., Mozer, M. C., and Pashler, H. (2009). Optimizing distributed practice: theoretical analysis and practical implications. *Exp Psychol*, 56(4), 236-246.

# Simulation with Team Deliberate Practice: Future directions, learning curves – optimising learning



## **Appendix 15 - Dissemination of study findings**

## Doctorate outputs – Alan Platt.

### Papers

- 1 Platt, Alan, Prescott-Clements, Linda and McMeekin, Peter (2018) *Debriefing with team deliberate practice: An instructional design to enhance the performance of undergraduate nursing students in recognising the deteriorating patient*. *Advances in Simulation*, 3(Suppl 2) p. 2
- 2 Platt, Alan, Prescott-Clements, Linda and McMeekin, Peter (2017) *Debriefing with team deliberate practice: Accelerating learning curves to maximise delivery and optimise participant learning in simulation-based education*. *BMJ Simulation and Technology Enhanced Learning*, 3 (2). A17

### Conferences

- 1 Platt, Alan, Prescott-Clements, Linda and McMeekin, Peter (2018) *Debriefing with team deliberate practice: An instructional design to enhance the performance of undergraduate nursing students in recognising the deteriorating patient*. In: Society in Europe for Simulation Allied to Medicine (SESAM) Simulation 24<sup>th</sup> Annual Conference, 27<sup>th</sup> – 29<sup>th</sup> June, Bilbao, Spain. **International – short listed for best conference abstract.**
- 2 Platt, Alan, Prescott-Clements, Linda and McMeekin, Peter (2017) *Debriefing with team deliberate practice: Accelerating learning curves to maximise delivery and optimise participant learning in simulation-based education*. In ASPiH's 8<sup>th</sup> Annual conference, 6<sup>th</sup> – 7<sup>th</sup> November, Telford, UK
- 3 Platt, A., McMeekin, P. and Prescott-Clements, L. (2014) *Debriefing with Team Deliberate Practice: Maximising Delivery and Optimising Participant Learning in Simulation Based Education*. In: The International Nursing Association for Clinical Simulation and Learning Annual Conference, 21 - 24 June 2017, Washington DC. **International**
- 4 Platt, A. (2016) *Simulation in England – Replacing practice with simulation: Ensuring quality in the design and delivery of SBE to optimise learning*. In: Nordic Conference on Simulation in Health Sciences Education, 3rd - 4th February 2016, Gjøvik Norway. **International, Invited Keynote**
- 5 Platt, A. (2015) *Optimising Participant Learning: theoretical perspectives in the design and delivery of Simulation Based Education*. In: InSiM: the interdisciplinary symposium on simulation in medicine, 16 - 17 October 2015, Munich. **International, Invited Keynote**
- 6 Platt, A. (2015) *Optimising Participant Learning: theoretical perspectives in the design and delivery of Simulation Based Education*. In: SimNAT: National German Simulation

in Nursing Education Conference, 15 October 2015, Munich. **International, Invited  
Keynote**

- 7 Kardong-Edgren, S., Decker, C., Platt, A. and Butt, A. (2014) *Deliberate practice and master learning: What, why, how and current nursing DP research*. In: National League of Nursing Education Summit, 17 September 2014, Phoenix. **International**
- 8 Platt, A., Allan, J., Tucker, G., Straughair, C., Scott, M., Prescott-Clements, L. and Unsworth, J. (2013) *Investigating the effects of deliberate practice on the performance, confidence, knowledge and motivation of undergraduate nursing student's recognition of a deteriorating patient*. In: Association for Simulated Practice in Healthcare Annual Conference, 19 - 21 November 2013, Harrogate, UK.
- 9 Platt, A., Prescott-Clements, L., Allan, J., Tucker, G., Straughair, C., Scott, M., Unsworth, J. and Moss, M. (2013) *Practice..., more practice, and deliberate practice: Investigating the effects of deliberate practice on the performance, confidence, knowledge and motivation of undergraduate nursing student's recognition of a deteriorating patient*. In: Association for Simulated Practice in Healthcare and Scottish Clinical Skills Network Scottish Symposium, 25 - 26 April 2013, Edinburgh.