Collaborative behaviours and professional culture traits in real-time interprofessional clinical simulation

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Abstract

Interprofessional education (IPE) has been proposed as a method of creating a collaborative practice ready workforce in healthcare. Postulated benefits of the technique include improving communication between professional groups, which in turn should help to prevent serious untoward events and ultimately improve patient outcomes.

Critics of the method have cited poorly designed IPE as a method of reinforcing physician power, and argued there is a paucity of data linking undergraduate IPE to tangible benefits in a patient-facing setting.

Simulation has been increasingly used as a method for delivery of IPE, with positive outcomes cited by students and educators alike. Virtual Patients and avatars have been recently used as a delivery method for healthcare education, but there is a paucity of data regarding their use in IPE. Simulation is not a panacea for IPE, many simulations focus on the acute phase of care naturally excluding healthcare professions who are not involved in those situations. Findings from acute simulations may not apply to sub-acute scenarios.

Method

A sub-acute real-time virtual patient simulation was designed then delivered to educators (n=6) and undergraduate students (n=33) from the professions of medicine, nursing, pharmacy and physiotherapy. Qualitative data was gathered according to a constructivist paradigm using unstructured observation of in-simulation behaviour, focus groups and semi-structured interviews.

Results

Data was analysed according to Braun and Clarke's method of thematic analysis. Five themes were identified: technology, education, collaboration, intrinsic behaviours and stereotyping. The simulation was educationally successful with participants citing improved recognition of the skills of other professional groups, and improved physiological and pharmacological knowledge. The real-time aspect of the simulation improved clinical reasoning and forced students to make prescribing decisions, which was cited as beneficial for future practice. The sub-acute nature of the simulation resulted in participants hyper-observing their VP to the detriment of patient care. Good levels of collaboration, team working and appropriate communication were facilitated but students were observed to subconsciously self-stereotype.

Conclusions

Sub-acute real-time virtual patient simulation appears to be a valid method of enabling students to learn with and from one another. It conveys benefit over traditional educational methods such as classroom –based, problem-based and experiential learning as students are given full responsibility for patient care with little supervision. Self-stereotyping amongst students suggests that students convey stereotypical messages about their own profession to others. This may aid team-building in the undergraduate setting, but if these stereotypical views are transferred to advanced practice, there may be detrimental consequences for team formation and patient care.

Key Words: Interprofessional education, team intelligence, simulation, virtual patient, communication.

DEDICATION

For Elsa Rapunzel our angel child

Ad Maiorem Dei Gloriam

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A wise old man once told me not to thank anyone by name as you always forget to mention someone, without fail he then proceeded to thank people by name. The writing of this thesis has been a long and arduous *camino* seven years in the making, it would be remiss of me if I did not thank people in person.

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Gratias

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GLOSSARY

A&E	Accident and Emergency
ABG	Arterial Blood Gas
Adult	The psychological state where humans make objective decisions based on logic.
AR	Augmented Reality. A technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view
Avatar	A cartoon or computer generated representation of a virtual patient (Bertie in our simulation).
BNF	British National Formulary
CAIPE	Centre for the Advancement of Interprofessional Education
Child	The psychological state where humans respond to others in an emotional, spontaneous or creative manner.
COPD	Chronic Obstructive Pulmonary Disease
CRM	Crew Resource Management - A technique used to inculcate secure leadership and assertive followership behaviour in air crews to increase passenger safety.
CXR	Chest X-ray
ECG (with respect to Bertie)	Electrocardiogram - in the simulation this screen functioned as a summary of the vital signs for the virtual patient
e-learning	Electronic learning, any form of learning mediated by technology
‘erlebnis’	The lived experience of a participant or researcher in a qualitative study
F1	Foundation Year 1 doctor
‘face’	The positive social value a person claims for himself by acting in a certain way
FTA	Face-threatening action. Any transaction which may threaten one's own or another's face
GBL	Games Based Learning

GMC	General Medical Council
GP	General Practitioner
GPhC	General Pharmaceutical Council
Hidden Curriculum	Lessons which students learn which are not explicitly taught in undergraduate curricula
IEPS	Interprofessional Education Perception Scale
IPE	Interprofessional Education
IPL	Interprofessional Learning
i/v	Intravenous
MDT	Multi-disciplinary team
m-learning	Mobile learning - learning facilitated by the use of mobile devices such as smartphones or iPads.
MPharm	Master of Pharmacy. The undergraduate qualification necessary for entry into the pre-registration year prior to final qualification as a pharmacist in the UK
NICE	National Institute for Clinical Excellence
NHS	National Health Service
NMC	Nursing and Midwifery Council
Paradigm experience	An experience which changes one's way of understanding and perceiving future situations.
Parent	The psychological state where a person acts to protect or discipline others, often an unconscious mimicking of authority figures from one's childhood.
PBL	Problem Based Learning
PSGB	Pharmaceutical Society of Great Britain (later the Royal Pharmaceutical Society of Great Britain)
RCP	Royal College of Physicians (London)
RCS	Royal College of Surgeons (London)
Reflection-in-action	Reflecting on a behaviour or course of action in the moment that it happens. May also be termed as reflexivity.
RIPLS	Readiness for Interprofessional Learning Scale
SimMan®	A high-fidelity simulation mannequin developed by Laerdal

Stereotype	A shared group belief about another group, often used as an aid to understanding.
Stroke	Otherwise known as an 'ego-stroke' the basic unit of human-human interaction in transactional analysis. They may be positive or negative.
Team intelligence	The active capacity of individual members of a team to learn, teach, communicate, reason and think together, irrespective of position in any hierarchy, in the service of realising shared goals.
'The app'	The delivery method for the virtual patient simulation
'The simulation'	The event in the study where participants interacted with the virtual patient and each other.
'The scenario'	The 'storyline' for the virtual patient, a 60 year old man admitted to hospital with shortness of breath and COPD.
UK	United Kingdom
UWE-IPQ	University of the West of England - Interprofessional Questionnaire
Virtual Patient (VP)	The computer programme which simulates the clinical scenario. Consisting of the avatar alongside all the calculations which produce vital signs and blood test results.
WCC	White Cell Count
Web 2.0	A variety of web sites and applications that allow anyone to create and share online information or material they have created.
WHO	World Health Organisation

PREFACE

This thesis maps a study which began in 2012 and ended in 2019. This journey involved the design, delivery and evaluation of a sub-acute interprofessional clinical simulation facilitated by virtual patient and mobile technology.

Chapter 1 details my literature review which describes the historical foundation of the three major healthcare professions involved in the study. The subsequent development of these professions and the man-made barriers created between professional groups in the late 19th and early 20th century UK, are articulated to the reader in order to provide the context for the development of IPE in the late 20th century. The creation and subsequent development of the NHS, is referred to with respect to major events which necessitated structural change and created calls for further collaboration between healthcare professionals. The development of the education of healthcare professionals in the UK is discussed and provides context regarding the introduction of IPE into undergraduate courses. Simulation, e-learning, mobile learning and virtual patients are then discussed with referral to overarching pedagogical strategies in education and a case is proposed for combining these approaches in order to develop IPE for nursing, pharmacy and medical students. A reflective account of my previous experience and interest in IPE is given at the end of the chapter to acknowledge the reflexive approach to research which permeates the thesis.

Chapter 2 details the methodological principles, research paradigms and methods used within the thesis. Detail of recruitment processes, the educational interventions and research strategy and analysis are included.

Chapters 3 and 4 detail the chronological collection of data from participants. Chapter 3 details data derived from phase 1 of the study and included a mix of student and lecturer participants. Four major themes were identified in the analysis: technology, education, collaboration and intrinsic behaviours. Chapter 4 details the data drawn from phase 2 of the study, where a larger cohort of students was investigated. One further major theme was identified at this stage, that of stereotyping.

Chapter 5 discusses results from chapters 3 and 4 which focus on educational outcomes of the intervention. Findings include postulated future uses of the technology, development of competency, reflection-in-action, and a discussion of the overarching educational paradigms inculcated by profession-specific education into students.

Chapter 6 then focuses on the behavioural and psychological interactions facilitated by the research. Results are discussed with reference to Berne's model of transactional analysis, and the development of team intelligence amongst participants. Intrinsic behaviours are divided into those which are useful for improving collaboration; and those which do not facilitate good practice. Finally a discussion of how students self-stereotyped during the simulation, and the possible consequences of this behaviour in practice is related to the reader.

Chapter 7 summarises the previous findings and draws some tentative conclusions and recommendations. Limitations are highlighted and future directions of work are explored.

CHAPTER 1 - BACKGROUND AND RATIONALE

1.1 Introduction

Victoria Climbé died on the 25th February 2000, at the age of 8 years and 3 months. The cause of her death was severe hypothermia and multi-organ failure, in addition 128 separate non-accidental injuries were recorded on her body. Victoria was subject to sustained physical abuse over the course of ten months by her guardians; many healthcare professionals had concerns for her safety, but these concerns were never appropriately actioned in order to prevent her death (1). She was known to two Housing Authorities, four Social Services Departments, two Police Child Protection Teams, a children's charity, and two different hospitals. The Laming Report (2003) highlighted that there was "a lack of joined-up working between agencies" and that failures in communication between healthcare professionals caring for Victoria allowed her to be released back to her guardians after an admission to hospital. This is by no means an isolated event; repeated, serious untoward events in the early 21st century UK showed that, frequently, healthcare professionals failed to collaborate effectively (2–4). Failure to communicate could be viewed at a superficial level citing factors such as individual hubris, and personality clashes. However the repeated nature of these events highlights the need to investigate the underlying factors that surround mistrust and poor communication between professionals.

1.2 The Historical Context of Collaboration in Healthcare

Today, the medical, pharmaceutical and nursing professions are clearly defined braches of healthcare; each with their individual interests and scope of practice. These divisions have not existed for time immemorial; some evolved over centuries, whereas some were man-made as a result of 'protectionism' (5–7). The history behind the foundation of the professions can give some context to the difficulties experienced in communication between the healthcare professions in the modern day.

Since the dawn of time people have attempted to diagnose and cure disease, known in Latin as *Ars Medicina* – the art of medicine. From antiquity until the present there have been opposing 'schools' of medicine, which use differing techniques and perspectives to treat disease. In ancient Greece there was conflict between the Knidian and Koan schools of medicine (8). The former concentrated in diagnosis whereas the latter focused on prognosis and care. Ancient Egyptian manuscripts such as the Ebers papyrus, and Edwin Smith papyrus are treatises on medicine and surgery respectively. *Ebers* includes 875 prescriptions, and includes the first mention of the *Pastophor* as the specific preparer of medicine, the forerunner of today's pharmacist (6,9).

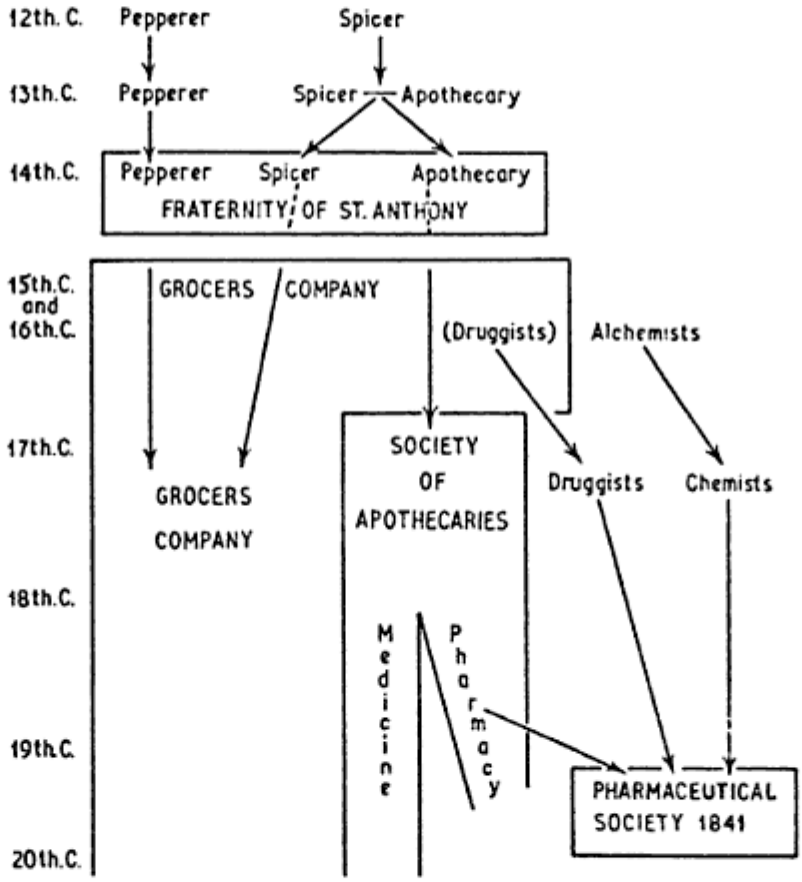
Hippocratic writings from circa 400BC mention the usefulness of trained attendants in difficult cases, and the Indian *Samhitas* speak of attendants who had the ability to prepare medicines, care for a patient's medical needs and to carry out a physician's orders without question (5). These attendants may well have been physicians in training but can also be seen to foreshadow the nursing profession. The earliest named nurse is Phoebe a 'deaconess' mentioned in the writings of St Paul (10). Constantine the Great via, the first council of Nicaea (325) ordered the building of a hospital in every cathedral town staffed by physicians and nurses, often both coming from religious orders (5). This led to one of the most common practices in modern health care: collaboration.

The hospital model of care was adapted readily in the Eastern Roman Empire, and this tradition was passed on to their Islamic successors. The hospital at Gondishapur, on the Persian Gulf became a great seat of medical knowledge until the capital of the Caliphate moved to Baghdad. Arabic scholars were famed for their interpretation of medicine, and they duly influenced the establishment of the medical school at the University of Salerno, Kingdom of Sicily in the 8th Century. The famous Pantocrator hospital (1136) was divided into wards staffed by two physicians, five surgeons and two nurses. In the West the invasion of barbarian tribes removed the necessary infrastructure for the building of hospitals. Much as in the East the Church provided the majority of healthcare, this was delivered via monasteries and convents and their associated infirmaries. When Charlemagne (747-814) required a physician for his court he had to appeal to the Caliph to furnish him with one. Salerno influenced the later Schools of medicine further west (Bologna, Montpellier, Paris), whom in turn introduced later English and German schools to the classical interpretations of Celsus, Galen and Ibn Sina (Avicenna).

The middle ages saw the division of medicine amongst many practitioners. Physic was inherently elitist requiring a University education; consequently the number of people entering the profession was small and failed to tend to the needs of the public. Self-medication, where patients or members of their family treated themselves, was an important aspect of healthcare throughout the second milennium AD (6). Many other practictioners offered their services to the wider public these included: surgeons, barber surgeons, apothecaries and herbalists. In England, much of their trade was protected by the guilds who protected entry and stipulated how apprentices should be trained, on the continent there was more involvement from the Government (5,6,10). The first documented disputes between these parties can be dated to the 16th century. The College of Physicians of London was granted a Royal Charter by Henry VIII in 1518 to grant licenses to persons qualified to practise medicine and to prosecute charlatans, quacks and those engaging in malpractice (11). Few licenses were granted by the Royal College of Physicians and fellowship was only granted to graduates of Oxford and Cambridge (5,6). The Reformation of Henry VIII, left a large gap in the care of the sick and elderly due to the dissolution of monasteries and convents which supported hospitals. Between 1536-1544 there was no help available to paupers in the City of London, which possibly expedited the formation of the United Barber-Surgeons company in 1540. By 1569 the City petitioned for the reestablishment of the hospital system using the ancient institutions of St Thomas, St Bartholomew, Bridewell and Christ's Hospital. Physicians tended to believe surgery was beneath them, anatomy studies had only become compulsory in the 14th century (5); whereas the Barber-Surgeons were more practical; performing procedures such as bleeding, cupping and teeth extraction. The word profession also entered the English vocabulary in the 16th Century with medicine, divinity and law the first learned occupations to refer to themselves as such. Medicine became a profession by developing an independent body of knowledge, which it jealously guarded (5,6,12,13).

Already the physicians felt that no surgeon should practise physic, and in the early years of the 17th Century a new threat to their monopoly emerged; the apothecary. Originally members of the Grocers Company (see Figure 1.1) they successfully obtained a royal charter in 1617 to approve procedures for the preparation of medicines in London (5,6,14). Due to the lack of qualified physicians, apothecaries often visited patients in their homes diagnosing and dispensing for patients without a physician's prescription.

This caused tensions between Apothecaries Hall and the College of Physicians as the latter thought the former was practicing without qualification or appropriate learning. The reality of the situation was that apothecaries were more affordable and thus consulted more frequently than physicians; and at that time there was very little difference in treatment outcome between self and physician mediated medicine. The issue came to a head with the Rose case of 1704 (15) the outcome of which stated that apothecaries were within their right to both prescribe and dispense medication. As a result the apothecaries were ratified as members of the medical profession and evolved into today's general practitioners (6,14), however this far from united the medical profession, and the divisions between physicians, surgeons and apothecaries continued until the mid-19th century.



Evolution of pharmacy in England (with special reference to London) from its beginnings to the present day. (Diagram courtesy of Trease, G. E.: Pharmacy in History, p. 32, London: Baillière, Tindall and Cox, 1964)

Figure 1.1 The development of the pharmacy profession from 12th to 20th century

The move of apothecaries into a more advisory role, created yet another gap in the provision of medical care. The chemists and druggists (the forerunners of todays' pharmacists) developed their own area of preparation and supply of medicines. In Britain, the chemists and druggists can trace their genesis to the early 18th Century, an age of unprecedented growth and consumer driven healthcare. They were differentiated by the prominence they gave to the retail side of their business; their shop fronts containing carboys with brightly coloured chemicals which attracted members of the public. The chemists were not restricted by the guild system and were founded on the principles of free trade and competition, often dispensing items for less than the apothecary. The apothecaries resented this and in 1748 attempted to gain control of chemist and druggist activities. This failed in parliament as there was a perception that the medical profession should be placed at the mercy of the consumer, and suspicion of organisations that sought to monpolise their practice.

The 18th and 19th centuries saw great advances in knowledge in science and medicine, these were combined with a desire to 'professionalise' the services of practitioners.   Physicians were the first group of healthcare workers to refer to themselves as a profession, and the surgeons spilt from the barbers in 1745 to form the company of surgeons. The apothecaries wished to follow suit with efforts relying on both on the protection of titles and services and the standardisation of education. The Apothecaries Act of 1815 (16) allowed the worshipful society of apothecaries to set up a court of examiners and grant licenses. The apothecaries wished to extend these regulations to the chemists and druggists. The chemists and druggists united against this and successfully argued for section 28, which exempted them from any provision of the Apothecaries Act (6). There were many calls from within the medical profession itself for reform. The medical reform movement was championed by the likes of Thomas Beddoes and Thomas Wakley, founder of *The Lancet*, who argued that the medical profession had to free itself from control of the consumer, and that the free market in healthcare had to be abolished in order to increase the prestige of the profession.   The chemists and druggists attracted much negative press from Wakley and *the Lancet* however they argued that the poor would rather patronise chemists than be patronised by general practitioners and physicians (17). Wakley's ire did not stop with the chemists, *the Lancet* often portrayed the medical profession and especially the Royal Colleges as rotten with corruption. Wakley himself believed that the medical profession would never achieve its rightful status unless the antagonistic and anachronistic branches of physic, surgery and pharmacy were combined into one whole (5,6,12,18). As a result between 1840 and 1858 no less than 17 medical reform bills were introduced to the House of Commons. Medical reformers tended to focus on three major issues: Occupational closure (either restrictive or definitional), Political representation (GP's could not sit on the council of either the RCP or RCS), Education and Examinations (GP's had needs not being met by the royal colleges).

In 1841 Thomas Wakley introduced a bill which attempted to reform the entire medical profession including chemists and druggists. His proposed reforms included the standardisation of qualifications from the 19 self-appointed medical bodies, however they also recommended placing chemist and druggist activity under the control of the apothecaries, restricting the right of the chemist to counter prescribe medication. This galvanized the foundation of the Pharmaceutical Society of Great Britain (PSGB), their first aim was to protect the rights of chemists and druggists to counter prescribe, give medical advice and practise minor surgery (6). This set into motion a series of political acts whereby the physicians, surgeons and apothecaries (general practitioners, GPs) merged into the medical profession as we know it today, and the chemists and druggists separated from them and became the pharmaceutical profession. This was socially and politically constructed via three acts of parliament: the 1852 Pharmacy Act (19), the 1858 Medical Act (20) and the 1868 Pharmacy and Poisons Act (21).

These reforms allowed the Royal College of Physicians to reconfigure the role of the doctor as public servants, and pillars of the community. Research in areas such as anaesthesia and sanitary medicine reinforced this new public perception of the profession. The Pharmacy Act (1852) established a register of pharmaceutical chemists, granting entry to any person who took the society's examinations. However it also stated that no member should practise physic or surgery; and if a member gained such qualifications they must renounce their membership. This gave a legal framework to the division between the medical and pharmacy professions, and mutual mistrust began to fester between the two (6). In the slums of Victorian Britain the chemists and the poor law doctors were often in competition to provide services. In Bristol a dispensing fee of 6d from a chemist, undercut the general practitioners 18d charge.

At the same time Florence Nightingale and Mary Seacole laid down the foundations for modern nursing practice in the Crimean War (1853-1856). Nursing had been inextricably linked with female religious orders in Europe since the time of Charlemagne, and thus the dissolution of the monasteries in Britain had caused the profession to enter something of a nadir. Nursing orders in France and the Latin countries had continued to proliferate, and Nightingale had been influenced by a Protestant school founded at Kaiserwerth in Germany. Nightingale combined her care for the sick with advances in hygiene and epidemiology which resulted in a decline in mortality rates at Scutari from 42.7% to 2.2% (5). She continued her work on her return to the UK with the establishment of nurse training school in 1860 at St. Thomas Hospital (22). Before this nurses were poorly paid and often recruited from prisons (7).

Nightingale strived to improve the public image of nursing and recruit educated ladies from the middle classes. Care was to be based on three core values: compassion, observation and knowledge. She required firm discipline from her students alongside a dedication to nursing, which established a corporate identity which spread through the British Empire (7). Professional standing for nurses was slow to materialise, the British Nurses Association was granted a Royal Charter in 1892. However the development of a professional identity led to clashes with the medical profession. As early as 1880 nursing leaders questioned if there should be a public examination before entry onto a register; however it was not until 1919 when nurse regulation was established and the General Nursing Council formed (23). The trigger to establish nurse registration had been the creation of "Voluntary Aid Detachments", sent to aid nurses struggling to cope with the demands of treating the victims of the First World War. These volunteers had returned to the UK and threatened to dilute the skills of the nursing profession, the establishment of a register protected the status of the trained nurse, and allowed nursing to become both a profession and an aspirational career in the 1920s.

The three professions of medicine, pharmacy and nursing continued to develop and deliver care in their areas of specialist interest. Collaboration between these various practitioners purporting to care for people and to treat disease was not always forthcoming and was often viewed as an unnecessary hindrance. The common aim for practitioners at this time was to 'professionalise' and protect their services.

After many years of increasing professionalisation the early 20th Century UK, the three professions would soon be forced to work for one national organisation in the biggest upheaval in the delivery of healthcare in the 20th Century. The fallout from the First World War and the Great Depression of the 1920s increased the demands on health services, and labour movements and unions campaigned for better conditions for the working classes. These external factors combined with internal influences from within the professions created the environment from which the NHS was born.

1.3 Foundation of the NHS and its' Impact on Healthcare Collaboration

This drive toward professionalisation also led to altruistic calls from GPs and politicians for the improvement in access to healthcare (24), but healthcare professionals still required renumeration for this. This culminated in the formation of the National Health Service (NHS) in 1948, a system designed to be free at the point of service and based on need rather than means (13). In the UK the history of healthcare is inextricably linked with that of the NHS. Founded in 1948, the NHS is viewed as one of the biggest successes in healthcare since World War II (25,26).

The beginning of altruistic care in the UK can be traced back to Lloyd-George's National insurance Act of 1911, which led to workers receiving free treatment from their GPs, although their families still had to be insured privately. The Dawson report (1920) (27,28) envisaged what a national health service may look like (Figure 1.2). With every town having access to primary and secondary care services, with links to tertiary teaching hospitals where necessary.

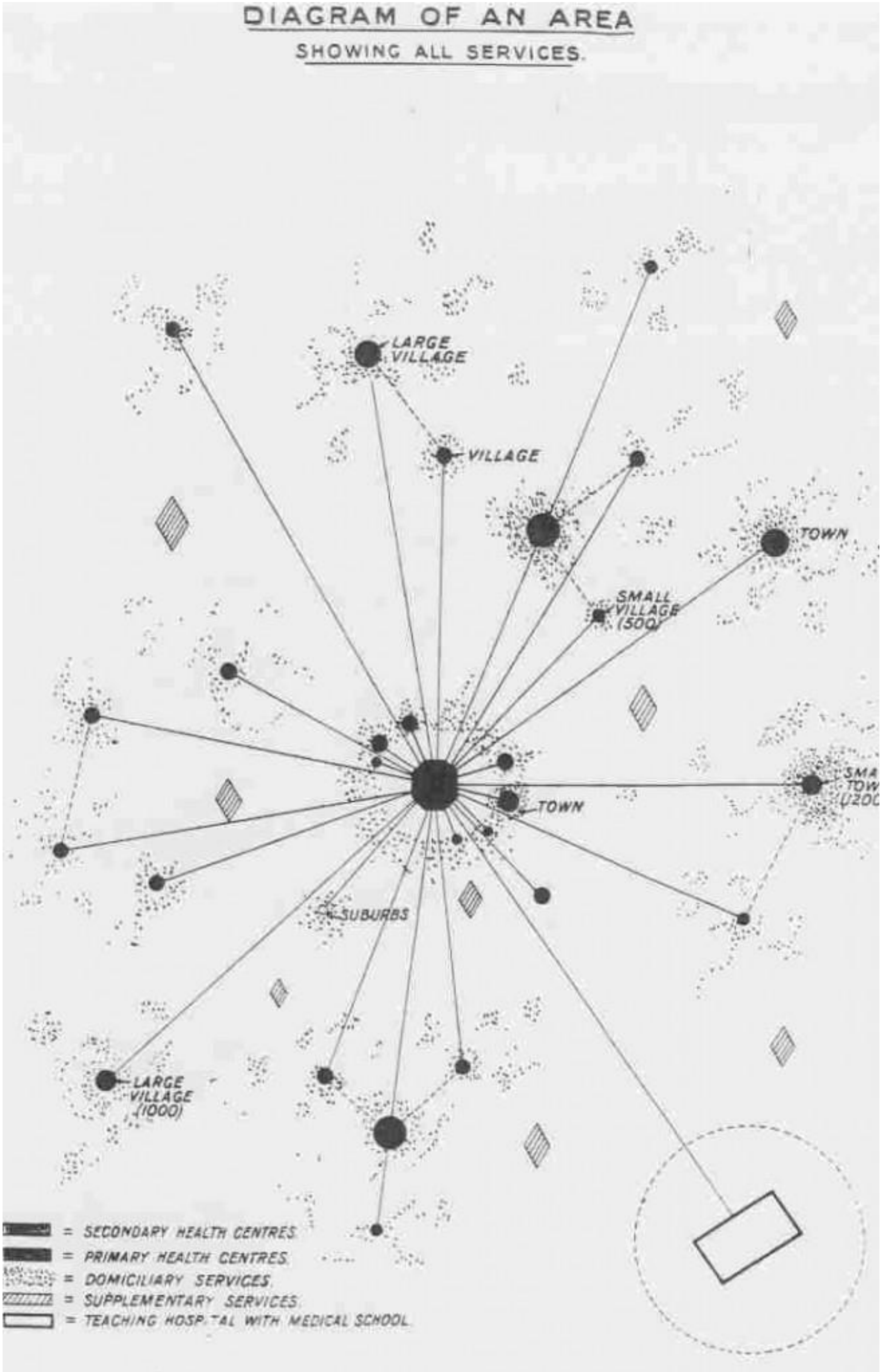
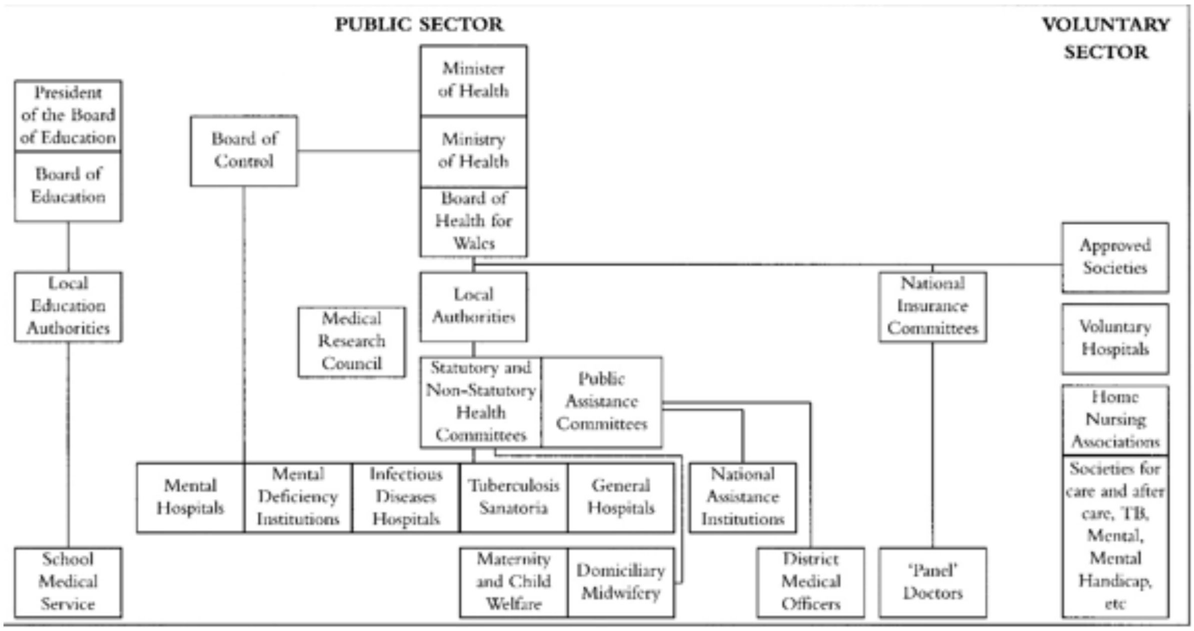


Figure 1.2 Conception of an integrated healthcare system – Dawson Report 1920

Winston Churchill commissioned the Beveridge report (29) which reinforced the idea that a national health service would be of benefit for the nation. The increasing interference of the state in medical matters caused by the proposal of a national health service was not viewed positively by all the healthcare professions. The British Medical Association had particular concerns about doctors becoming “servants of the state”(13), whilst also worrying about the restriction of a physicians’ autonomy caused by a state run health service.

Since it’s foundation, the NHS it has been subject to criticism from a wide variety of sources. These have included the limitation of physician power (13,30), sustainability (27,31–33), and poor organisational structure (1,4,27,34–42). In response to these needs the ministry of health (subsequently the Department for Health and Social Security (DHSS) and Department of Health) has commissioned various reviews into how healthcare is both delivered at a patient level, but also encompassing how services are organised at a local, regional and national level. In 1948 the NHS inherited a complicated, fragmented network of healthcare providers that had formed over the last century in a piecemeal manner (Figure 1.3). Large teaching hospitals had long been established in London, providing both care and the lions’ share of medical training placements in England. These institutions wielded considerable influence amongst the Royal Colleges and the British Medical Association (13). Local authorities were responsible for providing healthcare for the poor and they achieved this via entities such as the municipal hospitals, tuberculosis sanitoria, and mental asylums whilst also taking responsibility for ‘sanitary health’. ‘Voluntary’ hospitals were funded privately but often demanded great prestige, had long waiting lists and large outpatient departments also cottage hospitals existed where entrepreneurial GPs were rediscovering surgical skills. In addition to this a school medical service was provided under the auspices of the Local Education Authorities (13,43).



Source: C. Webster, The Health Services since the War, ii, Government and Health Care. The British National Health Service 1958-1979, (London, The Stationery Office, 1996), p786.

Figure 1.3 Health provision in England and Wales, 1939

The Health Minister of the Atlee Government, Anneurin Bevan conceived a tripartite structure for the NHS (Figure 1.4).

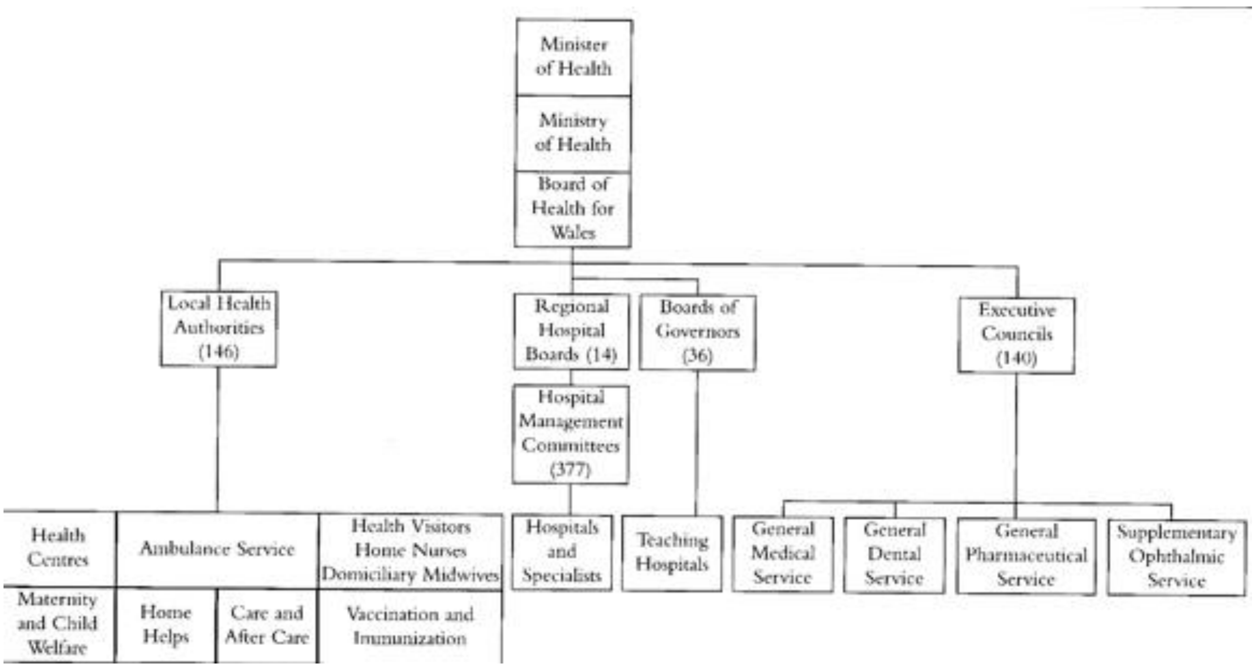


Figure 1.4 Bevan's National Health Service in England and Wales, 1948

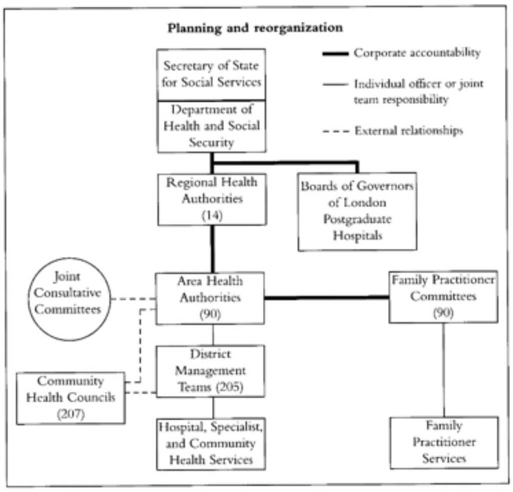
It is worth noting; in much the same way as George Orwell wrote in Animal Farm, "some were more equal than others". A two tier system developed where the governing bodies of teaching hospitals reported directly to the ministry whereas the municipal and provincial hospitals were governed by 14 new Regional Hospital Boards which in turn reported to the ministry (13,43). This reinforced the power and influence of the major teaching hospitals, which were concentrated in London resulting in the creation of regional health inequalities in the later years of the NHS (25,27,44). The third arm of Bevan's new NHS consisted of executive councils responsible for the delivery of primary healthcare (GPs, dentists, pharmacists and optometrists). This system was by no means efficient and often led to conflict and miscommunication between the different providers of care. It was soon noted in parliament and within the health professions themselves (31,36,45) that the system put in place required adjustment in order to allow disparate practitioners to integrate their provision. The NHS conceived by Bevan in 1948 was not the integrated system envisaged by Dawson and Beveridge.

1.4 Integration of Healthcare and Policy Changes in the UK 1948-2014

Occupational boundaries within healthcare were man made in the 19th century (6,19–21) and often hindered the care that patients receive (18). One of the first attempts to improve collaboration within the NHS occurred with the commissioning of the Jameson Report (36). After repeated attacks on the work of health visitors from both GPs and social workers, a Government working party was commissioned clearly define the boundaries and expectations of health visitors. Arthur Blenkinsopp MP, noted "co-operation between GPs and health visitors lacking in many cases at the moment" (46). The Jameson report recommended that health visitors should be responsible for basic health interventions with families and be able to recognise signs of social dysfunction. Around the same time the GP John Bodkin Adams was tried for the murder of one of his patients. This caused an outcry and a call for GPs to be more strictly regulated; this led indirectly to the creation of GP partnerships introducing a degree of peer supervision to the profession (13). The minister of health, Enoch Powell amongst others noted that as the infrastructure of the NHS was generally Victorian, it would be extremely difficult to break down everything these great institutions stood for in order to modernise the delivery of healthcare at the patient (37). Various reports in the 1960s level (37–39,47) highlighted that the infrastructure of the NHS was failing patients. It was noted that the health service and medicine in general had progressed dramatically since the late 1940s, and some of the institutions put in place to govern the NHS were actually hindering care. Powell's water tower speech (37) acknowledged that institutions were hard to change and the scandal at Ely hospital, Cardiff in 1969 (39) clearly encapsulated the problems Powell spoke of some years earlier. Mental health institutions had been standalone hospitals until the 1950s, rarely interacting with other healthcare providers. Many had their own cemeteries (5,13). Ely was an isolated mental health institution providing outdated care, inadequate training and supervision of staff which resulted in patient harm. The lack of integration between Ely and local social services was cited as a reason for patients never being discharged.

It was also reported that integrated work within hospitals was suffering due to increased staffing levels. The 'cogwheel' report (38), stated that as the numbers of consultants had doubled since 1948 communication between specialities had suffered. Previously, all consultants would share a common room, and know each other well and refer to each other as necessary. Due to increasing numbers, it was no longer physically possible to share a common room. As such, knowledge of practises outside a physicians' speciality lessened. By 1967 there was often more than one consultant working in a given speciality within a hospital. "Cogwheel" recommended the creation of divisions based on clinical expertise within the hospital, thus creating some of the first intraprofessional boundaries in UK healthcare. This created further hierarchical titles and structures within medicine reducing opportunity for rank and file professionals to collaborate (13).

The repeated finding that poor organisational structure led to breakdown in communication and collaboration, which then resulted in poor healthcare outcomes for patients; expediated a reorganisation of the NHS. The Department of Health and Department of Social Security merged in 1968 to form the Department of Health and Social Security (DHSS) in an attempt to strengthen links between health and social care. This process culminated with the NHS Reorganisation Act 1973 (Figure 1.5) (43,44).



Source: C. Webster, The National Health Service: A Political History, (Oxford, Oxford University Press, 1998), p108.

Figure 1.5 The NHS reorganization 1973

This structure remained largely unchanged for the next 25 years but problems with the delivery of health care continued. In 1976 the document *Sharing resources for health* (48) identified what became known in the late 20th century as the postcode lottery of NHS funding. A redistribution of resource from the South East to the provinces was recommended, however this was hampered by the internal structure of the NHS. As the majority of teaching hospitals were located within London, and their boards of Governors had a direct link to the DHSS, progress was stifled (44). The Callaghan Government (1976-1979) established a working party to investigate health inequalities for the first time since the War. This would eventually produce the Black Report (27), however a delay caused by a fundamental disagreement between two committee members caused it to report to the Thatcher Government (1979-1990). The Thatcher administration were less sympathetic to the issue of health inequality and attempted to supress the findings. The Black report was leaked to the press rather than being officially reported (44).

The Thatcher Government established a path to privatisation for many public services and commissioned two reviews into working practices in healthcare. The first (40) eschewed that the consensus management style so important for facilitating collaborative working in the NHS was inefficient and these clinical managers should be replaced by general managers. The

Enthoven Report (1985) expanded upon this repeating Powell's claim of 20 years previous, claiming that the NHS as a whole was stifled by an inherent resistance to change, and that an environment that drives quality and efficiency improvements must be created (32). The response created what became known as the internal market (41). NHS trusts and stakeholders would tender to provide services, thus reducing the cost of delivering care. At the same time the paper *Promoting Better Health* (49) envisaged an extended role for nurses and allied health professions within the NHS. The white paper proposed a paradigm shift in power by extending prescribing rights beyond the medical profession; which was viewed positively and negatively in various quarters of the NHS. The medical profession questioned the ability of others to take on the prescribing role. The pharmacy profession argued once again that their right to "counter prescribe" for minor ailments had been enshrined in the Medicines Act of 1968 (50), and that extending those rights would be desirable for the general public. Others thought the Government were attempting to cut costs by replacing doctors with cheaper healthcare professionals. Again, this caused consternation between the professions.

Innovations in healthcare in the late 1980s and early 1990s were framed in terms of patient choice (41), one of the first times that patients were actually consulted and given a voice to express their opinions of the health service. With the election of a Labour Government for the first time in 18 years *The New NHS* (42) and *The NHS Plan* (25) heralded an unprecedented wave of new investment and optimism regarding healthcare in the UK. Associated documents such as *A Spoonful of Sugar* (51) and *An Organisation with a Memory* (52) focused on reducing the harm caused to patients.

Around the turn of the millennium the cases of Beverley Allit, Harold Shipman and the Bristol Childrens Hospital heart scandal; closely echoed those of John Bodkin Adams and Ely. Patients were still suffering as a result of rogue practitioners, a lack of whistleblowing or a reluctance to challenge perceived authority within the NHS. *An organisation with a memory* (52) was designed to help the system learn from previous errors and thus continuously improve itself. The NHS Plan (25) gave impetus to parties who had advocated collaborative practice. The removal of the internal market and extension of prescribing rights both encouraged and facilitated joined-up working between healthcare professionals. The case of Victoria Climbé (1) highlighted what could happen if professionals repeatedly failed to communicate effectively. Analysis of further cases of child and patient abuse in the UK have highlighted the importance of collaborative working in healthcare (4,34,35).

These examples of poor practice naturally raised questions in the public domain. How could health professionals fail to spot the warning signs of child abuse, how could they fail to communicate effectively with each other? Naturally solutions were sought to prevent other serious untoward events from occurring in the future. One of the major areas of focus was on the initial education and training of healthcare professionals.

1.5 Education of Healthcare Professionals

Professionalisation of an occupation involves having specialist body of knowledge, a valued role in society and having some means of internal regulation. Education is vital to the maintenance and extension of that body of knowledge (5,7,12,18). The Pharmaceutical Society of Great Britain (1841), the General Medical Council (1858) and the General Nursing Council (1920) established regulations for entry to their respective professions. The NHS inherited healthcare workers who belonged to a wide variety of regulatory and professional bodies and attempted to improve relationships between them. As medical and scientific technology advanced it was recognised that the education of the next set of healthcare professionals needed to change.

Since the Medical Act of 1858, doctors were expected to graduate from University with the ability to practise in any area of medicine. This represented a shift away from the previous method of being apprenticed to a surgeon or general practitioner. Aspiring doctors had to undertake two years of study in anatomy and the basic physical sciences (13), followed by three years of training in hospital by surgeons and physicians. In hospitals there was an established post-qualification structure with physicians and surgeons rising through the ranks from houseman to consultant. In 1948, doctors could leave University and enter general practice alone, without the need for any further education or supervision (13). The latter situation was far from ideal, there was a tendency to overload curricula and practising doctors were worried that students were more interested in memorising facts rather than using their powers of scientific enquiry (53).

Although schools of nursing had existed in the UK since the mid-19th Century, formal qualifications were not introduced until the foundation of the General Nursing Council in 1920 (7). The examination was based on a nurses' competence and resulted in qualification as a State Registered Nurse. World War II caused a chronic shortage of nurses and thus the 1943

Nurses Act recognised two additional grades, the State Enrolled Nurse (with no defined training standards) and the auxiliary with no formal training. When the NHS was formed, nursing students were victims of chronic understaffing in hospitals. Since the time of Nightingale and Seacole, training occurred "on the job" following an apprenticeship system, under the strict supervision of the Matron, who interviewed candidates personally. The profession had a high attrition rate and with large number entering and leaving the profession each year. Student nurses were viewed primarily as a much needed extra pair of hands and their educational needs were always viewed as secondary to those of the patient (13).

The Pharmaceutical Society of Great Britain established the training requirements needed to become a pharmaceutical chemist consisting of a major exam for members and a minor exam for associates. The 1852 Pharmacy Act gave protection to the title "pharmaceutical chemist" but resulted in the PSGB representing only a third of the chemist and druggists in the country. Chemists and druggists could set up without qualification, but they would often fail due to competition if they were ineffective. This situation was resolved with the Pharmacy Act 1868 which established the minor examination of the PSGB as the compulsory examination to become a chemist and druggist. The major examination, previously the test for entry into business now became an examination for the academically inclined (6,18).

Degrees in pharmacy were introduced in 1904 at Manchester but not recognised with respect to qualification until 1924 when the University of London introduced their BPharm. Following the Education Act of 1944, the chemist and druggist diploma was phased out and prospective pharmacists could either qualify via the PSGB diploma of Pharmaceutical Chemistry (Ph.C) or by a University degree followed by a period of practical training (54). Pharmacists could choose two paths to training in 1948 both of which consisted of three years followed by one year under the direct supervision of a practising pharmacist. By 1957 the entrance requirements for the Ph.C diploma were brought into line with degrees and by 1967 all students who wished to become pharmacists had to undertake a Batchelor degree followed by one year of pre-registration training.

Throughout the 20th Century various educational reforms in healthcare continued. The Platt report of 1944 recognised the dichotomy between the student nurses role as a practitioner and learner (45). Several reports over 30 years continued to highlight this as an area for improvement without actuating change. The first undergraduate degree in nursing was established in Edinburgh in the 1960s which coincided with a change in the focus of nurse education from apprenticeship to a theoretical model, and the addition of student centred methods of learning. In 1986 a new report, Project 2000 called for a radical overhaul of nurse education, encouraging the formation of links between schools of nursing and Higher Education Institutions, standardising training throughout the UK, and giving academic recognition of professional qualifications. Possibly the most important change was the recognition that students should be supernumerary to staffing levels (55). Both these outcomes paved the way for more interprofessional collaboration between nurses and other professions (7).

In 1993 the GMC responded to calls for better communication skills by encouraging medical schools to refocus their educational delivery with the document *Tomorrow's Doctors* (56). Prior to this funding was released to medical schools in order for them to appoint "Practice educators", professionals whose primary focus was their clinical work, allowing them to educate students with the appropriate currency of knowledge (13). *Tomorrow's Doctors* encouraged schools to adopt inquiry-based or problem-based models encouraging students to discover information for themselves (57), fifty years had passed since overloading of the medical curriculum had been noticed, and *Tomorrow's Doctors* could be seen as a culmination of that observation.

A 1986 Nuffield Report on Pharmacy Education (58) encouraged integration of the traditional areas of pharmacology, pharmaceutics, practice and chemistry with a focus on relevance to disease. The advent of clinical ward-based pharmacy in hospitals in the 1970s and 1980s had encouraged closer collaboration between pharmacists and other healthcare professionals. The Nuffield report recommended a new focus on these clinical skills, and communication skills were noted as paramount to improving links between pharmacists and other professions (54).

Thus by the early 1990s the professions of medicine, nursing and pharmacy had sought to respond to pressures from governments and the public to improve the standing and trust in their professions; and by extension the NHS itself. Medical and Pharmacy leaders had noted that well educated students did not always become well respected and proficient practitioners. Conversely the nursing profession had come to see the importance of a theoretical understanding of their role within the wider healthcare team.

Significant untoward events such as the Bristol Heart Scandal (2) had highlighted the importance of effective communication both between patients and healthcare professionals; and between differing professional groups within the NHS. Improved communication became a focus within undergraduate education as it was realised that healthcare professionals would need to be able to explain themselves to patients and also to co-operate and work together effectively. Professional drivers such as *Tommorow's Doctors* (56) forced universities and healthcare providers to respond to this new priority. One postulated method to improve communication and effective team building between undergraduate professional groups was noted to be interprofessional education (IPE).

1.6 Interprofessional Education in Healthcare

How to encourage healthcare professionals to work together effectively and efficiently has been a research question since the 1970s (59). As scientific knowledge increased and medical specialities expanded through the 20th Century, it was noted that patient care became more complex (13). Often the care of a patient with multiple co-morbidities was beyond the scope of one practitioner, the exponential increase in pharmacological therapies compounded by sociological trends such as improved life expectancy and the attenuation of family ties all increased demand on limited NHS services in the UK. Consequently health and social care professionals had to work together in an effective manner (60).

Project 2000 (55) the Nuffield Report on Pharmacy education (58) and *Tomorrow's Doctors* (56) engineered change within healthcare education in the UK. Doctors were taught to avoid paternalistic relationships and hubris, whereas the newly developed degrees and diplomas in nursing empowered the profession. In the background the devolution of prescribing rights from doctors to other allied health professions (41,49) highlighted the need for closer ties between professions and a culture of mutual respect.

Getting healthcare professionals to work together has not always been easy to achieve or effective. Repeated, serious untoward events in the early years of the 21st century UK suggest that frequently healthcare professionals fail to collaborate (2–4). In response to these high-profile incidents Pearson *et al* (2009) stated that there was significant benefit in interdisciplinary training to foster good teamwork skills across professional boundaries; and that this should occur with more frequency across disciplines (61). Changing the behaviours of qualified healthcare professionals in order to work together more effectively requires significant time, effort and expenditure. One solution proposed to alleviate these problems is undergraduate interprofessional education (IPE). Training healthcare professionals together before qualification is presumed to improve students' ability to collaborate both in the classroom and the workplace. However these assumptions require more rigorous assessment (62).

IPE is defined as "when two or more professions come together to learn with, from and about each other to improve the quality of care" (63). It can include both work-based and University based interventions, and both pre and post-registration learning experiences (64). Interest in IPE flourished following the Alma-Ata declaration (65) and various educational initiatives occurred across the globe.

There are many different methodologies of IPE reported, postulating how it will benefit students in the workplace. Most of the educational theory behind these interventions stems from a constructivist pedagogy drawing on work from Freinet (66), Miller (67), Bloom (68), Kolb (69) and Wenger and Lave (70) amongst others. Many terms are used interchangeably in the literature, thus it is worth defining them.

IPE is defined before as learning with, from and about other professions (63) and this term should not be used interchangeably with interprofessional learning (IPL). IPL can often be referred to in literature as shared or common learning and could be defined as "learning with other professions". This is usually a passive process where a common lecture or presentation is made to a multidisciplinary audience (60). The main aim of the session is to learn a skill or a new piece of knowledge and any interaction between professions is viewed as secondary to this. Passive IPL experiences are reported as frequently as truly active IPE experiences in the literature.

Within the professions themselves there was recognition of the need for collaborative working and IPE. The General Medical Council noted in 2003 that roles previously only conducted by doctors were increasingly being passed on to other healthcare professionals, causing overlap between professional boundaries. *Tomorrow's doctors* (71) was updated to respond to these trends, stating that students should understand and respect the roles and expertise of other health and social care professionals in the context of working and learning as a multi-professional team.

The Nursing and Midwifery Council (NMC) were also positive in their response to the call for further collaboration between professions. Their ideal of a proficient practitioner was one that collaborated with other members of the care team, and furthermore contributed to the learning of others by sharing knowledge and experience (72). The General Pharmaceutical Council stated that any interprofessional training should be experience-based and involve working on practices and procedures with other healthcare professionals (73).

Problem-based learning (PBL) was forwarded by WHO in 1988 as the cornerstone of IPE. Problem-based learning was developed by Christian Freinet (57) and is widely used in medical schools in the UK and North America to develop skills such as leadership, time management, communication and self-directed study. The literature reveals few reports of PBL being used to deliver IPE in the UK. This is probably due to economies of scale; the interprofessional education programme at Keele University has approximately 600 students per cohort across three years, which require division into groups of 12. Problem-based learning initiatives with cohorts of this size are invariably fraught with difficulties (57,74). These range from timetable clashes across professional departments, student engagement, space constraints, staff availability and predisposition to IPE, faculty constraints, funding and organisational difficulties. These factors would appear to make it reasonable that some Universities use IPL in large cohorts to achieve multidisciplinary learning outcomes set by regulatory bodies.

The barriers experienced by educationalists attempting to develop IPE curricula have often led to novel methods of delivery. Reported methodologies include:

- the use of high fidelity mannequins in real time simulations involving multidisciplinary teams sharing the care of a patient (75,76).

- interprofessional wards staffed by final year students from various professional groups (77–79).

These methods allow students to learn interprofessional skills in an experiential setting similar to what Lave and Wenger would describe as a community of practice (70).

IPE has been envisaged as a method of improving health services around the globe. A great number of interventions and solutions to improve collaborative practice have been postulated however there is still a paucity of robust data linking interventions to the skills required for practitioners to work collaboratively (62). So what makes an effective IPE intervention? The critical hypothesis behind IPE is that making students learn together will improve their collaborative skills, and allow them to work more efficiently as part of a team in the workplace. However there is very little clear cut evidence to show this despite over 30 years of research. In short an interprofessional education initiative should provoke an improvement in attitudes, knowledge and skills (64) in any student undertaking it, but measuring these attitudes and skills objectively, has proven to be difficult.

Recent studies have attempted to redress this balance. Pelling et al (2011) shared findings from a longitudinal study at Linkoping University. A hospital ward was set up which was entirely staffed by students from physiotherapy, medicine, nursing and occupational therapy, with limited supervision from qualified tutors. Students responded favourably to their two-week rotation through the ward, with nurses appreciating it significantly more than other professional groups (79). Long-term follow up of these students elicited that they felt more comfortable working in multidisciplinary teams compared to students who had studied at other universities in Sweden (80). Hallin and Kiesling (2016) continued with this line of enquiry noting both the sustainability and educational impact on undergraduate learning. The authors also noted when fully qualified professionals were used as substitutes for students, teamwork and communication suffered (81).

Poorly designed IPE may have a negative impact upon students (82). Pollard et al (83,84) conducted a longitudinal study on a cohort of students undertaking a newly developed IPE course at the University of the West of England. 723 students from nursing, midwifery, occupational therapy, social work and physiotherapy took part in the study. It was reported that second year students found IPE to be less stimulating and had a negative perception of IPE compared to their first year counterparts. The students communication and teamwork skills were still rated positively, however again there had been a negative shift compared to their 1st year results, possibly indicating an increased level of insight into their own abilities. The authors postulated that IPE may actually reinforce negative stereotypes of other professions if not carefully planned and evaluated. Similar work by Mandy *et al* (2004) reaffirmed these findings. Undergraduate students from physiotherapy and podiatry actively stereotyped each other prior to IPE; and the educational intervention reinforced these beliefs (85). The authors noted students embarking on a new profession identified strongly with it, and as such may be less willing to engage with other professional groups. The timing of an IPE intervention was acknowledged as crucial to avoiding stereotype perpetuation. Wackerhausen described the theoretical framework for these findings in 2009. He stated that for students to become fully fledged members of a profession they have to not only pass examinations; but have to *talk, think and behave* like other members of the profession (86).

Reeves and van Schaik (62) state that there is little questioning of the underlying assumptions of IPE, i.e. that any intervention will improve collaborative working amongst healthcare professionals in the workplace, and that this will improve patient care. They go on to state that most studies do not go much further than showing that a student 'knows' something - the lowest levels of Bloom's taxonomy (68) and Millers assessment of competency (67) . Kuper and Whitehead (2012) (82) expand upon this and go as far to say that IPE has become an ideology, and that it may reinforce power relationships between physicians and other healthcare professionals.

The Cochrane Collaboration commissioned three meta-analyses of interprofessional education initiatives to attempt to clarify if any significant patient-level benefits could be attributed to IPE (87–89). The researchers proposed two criteria for the review:

a) the paper should be designed as a randomised controlled trial, controlled before and after study, or interrupted time series study.

b) the paper should report validated objectively measured or self-reported patient/client and/or healthcare process outcomes.

The first review performed in 2000 identified no papers that matched the criteria, the second study in 2008 elicited six, all of which pertained to post-registration educational interventions. However, the usefulness of randomised trials for IPE has been challenged. It must be remembered that education is often evaluated in a dissimilar way to scientific studies, and that randomised controlled trials would often be viewed as unethical for a student cohort. Well-designed studies such as Pelling et al (2011) (79) which have reported professional-level improvements in competency failed to be recognised in the reviews undertaken by Zwarenstein *et al*. Olson and Bialocerkowski (2014) argue IPE is a centre of epistemological struggle, between positivist healthcare science research and educational theory (90). They argue for more qualitative studies which focus on interprofessional socialisation. The BEME reviews conducted by Reeves *et al* acknowledged the importance of high quality qualitative research in IPE (91), and also the need for new and improved methods for measuring outcomes of IPE at undergraduate level.

The case for IPE is compelling, however it is somewhat tempered by the weak evidence that it has benefits in practice. To this day patient safety continues to be compromised by the lack of communication between various professions, agencies and non-governmental organisations. Recently the cases of Daniel Pelka (92), Hamzah Khan (93) and Keanu Williams (94) only reinforce the lessons learned from the past, that collaborative inter-agency working in the UK is failing. Whether or not IPE has a role to play in the prevention of incidents such as these, remains to be seen.

The most effective method for the delivery of IPE is still to be elucidated. What works for one group of professionals may not even work with the same cohort one year later (84). Student self-reported skills may improve however some IPE events may even perpetuate stereotypes of other professional groups (85).

An increasing focus in IPE research involves the use of healthcare simulation, which aims to reproduce realistic patient presentations in a safe classroom setting (95,96). Healthcare in the 21st century naturally involves collaboration between many different professional groups and thus authentic simulation should involve practitioners from disparate disciplines working together for patient care. Reeves and Van Schaik note that simulation is not a panacea for IPE (62), and certainly early years students do not possess the skills necessary to engage with clinical simulation. However the potential for undergraduate students close to qualification to learn with, from and about each other in clinical simulation offers many possibilities for future investigation.

1.7 Simulation as a Pedagogical Method

The apprenticeship system, where students are exposed to real world scenarios, in a working environment has often been cited as one of the most powerful learning experiences. Einstein himself stated that "learning is experience, everything else is just information." In the UK in the 19th and 20th Centuries; all major healthcare professions eventually moved away from this apprenticeship system to a classroom-based, theoretical form of education. This move towards a theoretical education was forwarded because of the inherent frailty of the apprenticeship system. An apprenticeship focuses on the individual, an apprentice will only learn skills from one master, and thus training can be variable (5). Theoretical training is not without its' own limitations; it has been recognised that students who pass assessments in clinical knowledge in the health professions will struggle when presented with a real patient (57,97). Consequently there has been a renewed focus on experiential learning within undergraduate healthcare curricula. Experience is referred to as one of the five key factors underpinning successful learning listed by Race (98). Heidegger (99) and Gadamer (100) believe that experience is more than just witnessing events. They argue that experience only occurs when preconceptions are not confirmed by an event. Only when a situation refines, elaborates or disconfirms prior knowledge is an event *experience.* Kuhn (101) and Polanyi (102) both acknowledge that there is a fundamental difference between knowing *"that"* and knowing *"how"*, i.e. between practical and theoretical knowledge. This corresponds with Biggs and Tang's ideas around declarative and functioning knowledge (103). Spencer (104) recognises that despite a long tradition hospital wards are not the most suitable environment to teach in.

In recent years advancement in technology and an increasing pressure on placement providers has encouraged educators to develop novel methods for delivering curricula. Experiential learning in healthcare is often serendipitous relying on patient involvement and consent.

Simulating these environments offers a way for educators to mimic experiential learning in a controlled and 'safe' environment.

Scalese defined healthcare simulation in 2008 as *"A person, device or set of conditions which attempts to present the evaluation of problems authentically, readily available at any time, and can reproduce a wide variety of clinical conditions"* (105).

Healthcare simulation was adapted from the aircraft industry's experience, where it contributed significantly to safety improvements. A pilot is required to undertake many hours of simulated training with other pilots and cabin crew before taking charge of an aircraft (96). Inherent differences between the aircraft industry and medical practice have been cited as barriers to the adoption of simulation and other safety practises into medicine (106). Despite this, simulation has been enthusiastically adopted in healthcare for acute situations such as surgery and anaphylaxis. These scenarios share commonality with air travel as they have clearly defined start and end points. Advanced and intermediate life support skills are vitally important for healthcare professionals to have, however the situations where they are used may be few and far between in practice. Simulations afford trainee and experienced practitioners repeated learning opportunities where the consequences of mistakes do not result in patient harm (deliberate practise and mastery learning) (107).

For a simulation to truly replicate a healthcare environment there must be involvement from differing professions, naturally providing opportunities for IPE. As the majority of reported simulations in healthcare focus on acute settings (62), they exclude a sizable number of healthcare professionals whose practise will not extend to emergency situations. For instance, in the UK pharmacists are not front-line emergency care workers, their role lies in the sub-acute settings of primary and secondary care. Therefore a simulation for pharmacy students would have greater use if it was focused on a non-acute setting.

The majority of interprofessional collaborations in healthcare occur in low acuity settings such as primary care centres, wards, GP surgeries and community pharmacies. The research showing the benefits of simulation on healthcare professional behaviour in high acuity settings cannot be extrapolated to these low acuity situations (62), and as such there is a paucity of data regarding simulation for the care of chronic conditions. Small interventions focusing on low-acuity settings such as ward environments have demonstrated improvements in soft skills such as communication and hard skills such as prescription justification (75,108). As the NHS spends the majority of its funding on chronic conditions, including 10% alone on diabetes mellitus (109) it would be of benefit to research if simulation could be applied to these conditions as a learning intervention.

The argument for using simulations to deliver interprofessional education is strong. The Sydney declaration on interprofessional education states that core elements of healthcare worker training should include practical experiences of interprofessional education such as simulation (110). In undergraduate education simulation is an extremely useful tool to expose students to professional experiential learning in 'safe' environment (111). Simulations have also been shown to encourage effective team working, and interprofessional simulations have been found to be a 'powerful' learning experience (112). However the definition of 'safe' can be challenged. The overarching principle behind this statement focused on the simulation being 'safe' for patients, because no real patient can be harmed by a student in a simulation. However a simulation may actually be an extremely stressful environment for a student, they may feel pressure to perform, from both peers and lecturers. They may feel unable to communicate, or speak their minds due to either the fear of being wrong or because they are not yet confident with the material or the company of their fellow student professionals (77). This can lead to both anxiety and negative experiences for students, resulting in what can be referred to as a negative paradigm experience (97), making students less likely to actively take part in future simulations and creating what Light *et al* (113) would refer to as a learning gap.

Simulations can be defined as high or low fidelity. Fidelity is defined as the "degree of realism within a simulation". This can be affected by multiple parameters including the context, environment and resources provided to students. Low fidelity simulations give students minimal responsibility for their actions and involve an environment dissimilar to the real world. They may involve the use of actors as simulated patients for objective structured clinical examinations, or low cost equipment such as students injecting oranges before they inject patients. High fidelity simulations involve a high level of realism and responsibility for students. They can involve significant computer programmes and advanced technology including mannequins such as SimMan®, which model real-time physiological responses of patients to medication, or include haptic technology which give simulated tactile responses, and can be used for simulating surgical procedures. They can also include immersive virtual environments (114), or computerised virtual reality.

One of the most important aspects of any simulation is that it 'suspends reality' and that learners are totally immersed in the situation they are faced with (96). Haptics is both costly and may be of limited use to pharmacists who rarely perform physical examinations on patients. Another possible method of simulation would be via the use of virtual reality, or more explicitly virtual patients.

In pharmacy education recent research has focused on the use of virtual patients (VPs). Described by the Association for Medical Colleges as:

"a specific type of computer program that simulates real-life clinical scenarios; learners emulate the roles of health care providers to obtain a history, conduct a physical exam, and make diagnostic and therapeutic decisions" (115).

These are computer generated avatars or cartoons, which can interact with students or patients via computer or voice recognition software (116–118). The important features of a virtual patient include interactivity with the learner; simulation of medical conditions and either visual or physical representation of these conditions. The manifestation of the VPs can differ greatly and include case studies presented on webpages or CD-ROMs with still photos or video clips, immersive virtual reality simulations, and robotic human-scale mannequins. These virtual patients offer a great deal of flexibility when educating students and can allow for asynchronous feedback whereby students interact with the avatar at their convenience and then receive immediate feedback by means of the programme.

1.8 e-Learning

Although IPE and simulation have been recognised as an important part of healthcare curricula, several barriers such as time, space, location and staff training have been reported (119,120). Any educational technology that alleviates these issues should then theoretically be of use in the development of IPE. Distance learning courses have existed since the 19th Century (5). The Open University provides its courses solely via distance learning. Originally using correspondence courses and paper-based materials, the advancement of computer technology and the internet revolution at the start of the 21st century created a new and more convenient method to communicate over distance: electronic or e-learning. Studies have shown that e-learning increases the reach of education and allows greater access to unconventional students (121). Web 2.0 technologies such as skype are postulated to increase the effectiveness of distance learning by allowing for synchronous face to face interaction between student and teacher (122–124). MacDonald *et al* proposed a framework for online IPE in 2009 (125); and many studies have reported the benefits of using e-learning for IPE including collaborative problem solving, clarification of professional roles (126), the negation of logistical difficulties (127) and exploration of contentious issues (114). Despite this positive work in e-learning it was decided to focus the opportunities for simulated IPE provided by virtual patient (VP), and mobile technology available to the lead researcher at Keele University.

1.9 Mobile learning (m-learning)

One proposed technological solution to the problems of time, space, place and teacher is via the use of mobile technology. The average Briton spent 41 hours engaging with their mobile phone in December 2013 (128), with around 97% of the population owning one. Mobile phones have successfully been used to deliver educational material to healthcare workers (129) and to enhance communication between healthcare professionals in the hospital setting (130). They allow learners to engage with virtual environments in a variety of ways unconstrained by space or time thus allowing for new forms of learning taking place at times when a trainer is not present (131). The recent national mobile health worker project (132) commissioned by the NHS, although not strictly employing pedagogical evaluation, also shows that mobile technology could improve the efficiency of health services.

Mobile learning, often referred to as m-learning, is characterised by its ubiquity and by "learning on the move" (133). It is not just a case of giving students mobile phones or delivering teaching material through them, it is more a case of learners taking advantage of the learning opportunities afforded by mobile technologies (134). As mobile phones have become more common and the technology available to students through them has grown exponentially, it is not surprising that educators have started to research the possibilities afforded by these technologies. However both research and practice in mobile learning are in their infancy (135). There is some debate over whether educational theory needs to catch up with the technology (131). Research in m-learning currently appears to be active in two areas, firstly by augmenting curriculum centred classroom learning and secondly for learning on the move (135).

Most research into m-learning concentrates on progress reports and case studies. They elicit information about successes and obstacles they have encountered as well as participants reviews of the technology. The introduction of mobile learning devices into the classroom has led to increases in motivation to study (136). Case studies also report on the successful use of mobile technologies for distance learning and in resource limited settings (129). M-learning initiatives in the field of healthcare education include quiz based games (137), information based applications; and information gathering systems (138,139) which allow epidemiological information to be gathered at a central location in real time.

Traxler (140) argues that there is more need to construct the concept of m-learning based on learners' experiences rather than focusing on technology. Most m-learning initiatives have focused on changing classrooms or lecture theatres from teacher-focused pedagogies to social constructivist theories rooted in those of Laurillard (141), Wenger (70) and Vygotsky (142). Cochrane (143) speaks of the pedagogy, andragogy, heutagogy development process as a judgment of whether or not a m-learning initiative has been successful. He defines heutagogy as where students take control of their own learning objectives and propose innovative solutions to these objectives. His work builds on that of O'Malley *et al* (144) who developed some initial guidelines for mobile learning. A key competency for any healthcare professional is to be able to identify their own learning needs and to then take self-directed action to address those needs. Problem-based learning has been employed in undergraduate schools to develop student capability in this area. Given that many m-learning studies also wish for self-directed learning as an output i.e. developing heutagogy, it would be useful to evaluate whether or not m-learning is an effective tool for healthcare education. The educational success of an intervention could possibly be defined as a conversion of learning from a pedagogical to a heutgogical form. However for an intervention to be deemed successful in healthcare education, there should be an increase in knowledge that will ultimately benefit patient care.

Games- based learning (GBL) sometimes referred to as "edutainment", is another area where mobile technology has been used to facilitate healthcare education (145,146). GBL has been shown to be successful by putting 'fun' into learning (146,147). Educational games have involved simulating domiciliary visits where students were expected to identify risks by interacting with and exploring the living quarters of a virtual patient. This allowed for equity of experience amongst learners as not all students were able to experience this on placement.

It has been argued that educational games and m-learning facilitate heutagogy, a learning process driven by the student rather than the teacher, whereby the student chooses what, when and how to learn (148). The usefulness of heutagogy in healthcare education is questionable as educators need some degree of control about what students learn. Providing a framework within which students learn can be argued to be pedagogy as educators are still proscribing what a student must learn, just allowing license to explore the concepts as they see fit.

M-learning has been proposed as a useful tool in teacher education as teachers are naturally itinerant (149). The same could be said about qualified healthcare professionals; they are often multi-tasking whilst working in extremely stressful situations. As such, their time for learning, although proscribed by professional bodies (GMC, NMC, GPhC) is limited. M-learning allows for flexibility for the learner as they can access material from home, in the workplace and whilst travelling. Also practitioners can engage with virtual environments and communicate with fellow learners, who they otherwise would have no network with due to the constraints of space. In the UK, doctors, pharmacists and nurses must undergo revalidation in order to remain on their professional registers. Mobile learning would allow professionals to learn on the move, giving them a framework to bypass the more proscribed forms of experiential learning favoured by Kolb in favour of allowing a reflection-in-action model championed by Cochrane (143), Wiestra and de Jong (150), and Cornelius and Marston (151). This has benefits for the practitioner both in terms of time saved and patients in terms of increasing engagement with professional developments.

Thus mobile technology may create an opportunity to negate one of the most difficult tasks involved in developing IPE; that of timetabling. Combining the principles of GBL and healthcare simulation, a virtual patient (VP) may be designed to utilise mobile technology and allow healthcare professionals to learn with, from and about each other, whilst caring for a patient in a 'safe' environment.

1.10 How to make a Virtual Patient (or How to Design a Human)

Cendan and Lok defined a virtual patient in 2012 as: “a specific type of computer programme that simulates real-life clinical scenarios; learners emulate the roles of health care providers to obtain a history, conduct a physical exam and make a diagnostic and therapeutic decisions (115).” To simulate a real-life clinical scenario, the computer programme must play the role of a patient, in this case a human being. The design of a virtual patient must therefore bear some consideration of the question “What is a human?”

Aristotle defined man as a rational animal, with the hallmark of mankind defined by the power of speech as opposed to sound (152). A human has the power of speech setting forth the expedient and inexpedient, and likewise the just and the unjust. Thus, Man alone has a sense of good and evil. More recently Cottingham (2003) stated that humans require a certain moral resonance in order for their lives to be genuinely meaningful (153). The question of machines mimicking human beings was first proposed by Descartes in the 1550s, this work was continued by Charles Babbage and Ada Lovelace on their analytical engine. The question of what constitutes consciousness has been debated amongst the dualist and physicalist schools of philosophy for generations. Alan Turing (1950) tackled the question of artificial intelligence by avoiding the matter of thought and proposing his modified version of “the imitation game” as a way of defining whether or not a machine is sentient (154). In what has become known as the *Turing Test* is person C asks questions (via writing) for five minutes of persons A and B, where A is a machine and B is a real person. If person C cannot detect which respondent is the machine within the timeframe then the machine is said to have intelligence.

To convert a human being with all his frailties and moral resonance into a computer programme would be an inherently tortuous process well beyond the scope of a PhD thesis.

We do not wish to design a programme which could pass the "Turing test" and demonstrate artificial intelligence at present, but it is a potential direction which could be taken in the future.

The medical model of care (Laing, 1971; Mosby 2009) offers a more focussed and perhaps simplistic and mechanical definition of what constitutes a person. Used since the 19th Century a traditional medical model focuses on a defect, or dysfunction, within the patient, using a problem-solving approach (155,156). The medical history, physical examination, and diagnostic tests provide the basis for the identification and treatment of a specific illness. The medical model is thus focused on the physical and biological aspects of specific diseases and conditions. Augmenting this model, nursing care is formulated on the basis of a holistic nursing assessment of all dimensions of the person (physical, emotional, social, mental, and spiritual) that assumes multiple causes for the problems experienced by the patient (156). Pharmaceutical care has been defined as a systematic approach to ensure that the patient gets the right medicines, in the right dose, at the right time and for the right reasons (157).

Designing a virtual patient simulation which replicates what happens in a subacute scenario is an inherently complex and tenuous process. However if we necessarily simplify a person into a virtual patient exhibiting key characteristics or traits which can be identified using a medical model, then we are somewhere closer to a solution.

Vital signs such as the temperature, heart rate and respiratory rate; and blood tests such as urea and electrolytes are often used as biomarkers in assessment, diagnosis and prognosis of a patient. They are often labile results changing in response to physiological adaptation and pharmaceutical intervention. A virtual patient can be designed to have vital signs which respond to user input. To add a layer of authenticity patient behaviours (such as wheezing or agitation) and verbal responses can be modelled to respond to changing vital signs.

1.11 Conclusion

Some of the most well received interprofessional education initiatives have involved IPE training wards (78,112,158,159). An IPE training ward is often completely staffed by later year students from undergraduate programmes in nursing, medicine and allied health professions; looking after real patients with minimal supervision from qualified staff. Students undertake all the routine care on the ward, assume a high level of responsibility for their patients, and may be involved in daily team conferences and reflection sessions with students and tutors. A concluding seminar is held at the end of each 2-week rotation; at this time, emergent problems related to professional and interprofessional conduct and the quality of care are investigated and discussed. These have allowed students to combine both interprofessional and experiential learning together to care for a real patient. This has improved both student perception of IPE and their capability to implement collaborative care for their patients years later when acting as fully qualified healthcare professionals (80).

Current trends in the UK in medico-legal ethics, the need for a medical school and prohibitive cost reduce the possibility for more of these training wards being implemented (60). Due to this, technology has been proposed as a solution, and virtual environments are being used to deliver interprofessional learning as these do not propose that real patients are cared for by students. Quinney et al (114) reported their experiences of using a virtual community "Wessex Bay" which allowed students and tutors to communicate online using synchronous and asynchronous technology. Whilst students initially struggled with the technology, they appreciated the realistic interpretation of patient care (70), and noted that visual aids helped with their learning.

Although the results of these studies have been widely disseminated it is clear that one of the major healthcare professions is missing in the multidisciplinary team – pharmacy. Undergraduate pharmacy education in the UK currently consists of four years of undergraduate study followed by one year of work-based experience (the pre-registration year). There is wide variation in patient contact hours amongst undergraduates in UK Universities and as such some students may have little experience interacting with patients. Out of 30 pharmacy schools in the UK only 15 are affiliated with medical schools (160). This may be why no IPE ward evaluations have included pharmacy students and, when combined with the fact most simulations are set acutely why there are few studies exploring simulation for pharmacists.

It appears that m-learning may be a useful method of delivering an interprofessional simulation. However Barr sounds a note of caution when introducing technology into IPE, he states that under no circumstances should technology drive the IPE, it must always be exploited in an appropriate manner as an adjunct to the intervention. Gordon, Booth and Bywater (2010) state that there is a new e-pedagogy for IPE and that there is a danger if technology replaces face to face interactions between people (161). Turkle in her book *Alone together* (162), notes that interactions mediated by social media such as Twitter and Facebook lack authenticity. As such if technology replaces the need for face to face collaboration, then the output of any interprofessional intervention may be lessened.

IPE can be difficult to both implement and deliver effectively, due to lack of student time, engagement and difficulties with travel. Delivering an interprofessional simulation via mobile technology both negates the need to timetable IPE, and for a great number of facilitators to be trained. This also affords students the opportunity to be in control of their learning (heutagogy). Undergraduate pharmacy students have had limited exposure to clinical simulation and IPE wards, possibly due to constraints on time, location and experience. A simulation utilising m-learning would potentially remove some of these barriers, allow pharmacists to actively participate in simulation, improve collaboration between healthcare professionals and improve educational subject knowledge for doctors, nurses and pharmacists.

It is proposed to combine m-learning, virtual patients, GBL and IPE to deliver a simulated virtual patient scenario, to an interprofessional group of undergraduate medical, nursing and pharmacy students via means of a mobile phone application. It is hoped that these disparate areas of educational technology will complement each other and solve some of the challenges faced in the delivery of effective interprofessional education; Namely,

a) be achievable and deliverable
b) have a positive educational impact on students
c) improve students ability to work collaboratively with other healthcare professionals

The simulation will be designed to mimic the path of a patient through an admission to a hospital ward, each professional group of students will be expected to perform their professional role and collaborate where necessary. No previous studies have focused on combining these areas of education and technology together, and thus this should add to the body of knowledge.

1.12 A man in the wrong profession? A reflective account of my interests in IPE

I am the fourth son of parents born in Salford in 1937; I was brought up with three elder brothers in a working class suburb of Wigan. I was the first member of my extended family to enter a caring or medical profession.

My interest in pharmacy stemmed from wanting to enter a 'caring' profession but not wanting 'poke around in people's guts' like a doctor. My earliest healthcare experiences related to a volunteer role in the Liverpool pilgrimage to Lourdes. I thoroughly enjoyed the social and interactive aspects of personally caring for vulnerable, elderly and sick people. This helped to hone my communication skills with patient and also to work as part of a wider healthcare team involving doctors, nurses and other inexperienced volunteers such as myself.

During my formative years as a student and pre-registration pharmacist I started to notice that pharmacists often were not integrated into ward-based teams. On reflection this was probably a combination of personality characteristics and the overarching culture on different wards. In one memorable lecture at University I remember being horrified that most pharmacists preferred the theorist and reflector learning styles articulated by Honey and Mumford (163); I certainly fitted better into the activist and pragmatist styles of the same model. This is probably the first time I realised that I displayed traits which Austin and colleagues would refer to as atypical of a pharmacist (164–167).

Later in my training it became clearly evident that amongst my fellow cohort of student pharmacists I was one of the more confident and articulate students; confident enough to deliver presentations on behalf of colleagues and unafraid of giving the wrong answer. Throughout my pre-registration year I was inculcated with the behaviours and communication skills expected of a pharmacist: concentrate on medication, try to keep things short and polite, be sure of what you want to happen before discussing problems with medics. I was frequently told to leave other questions and issues to nurses, don't answer the phones on the ward. I was actively living out what Suzanne Gordon would later describe as 'parallel play with intimate strangers at the patient's bedside.'

After qualifying as a pharmacist I went to work in what I still consider to be the best job I have had in my career, at Wrightington Hospital in Lancashire. There was great camaraderie between myself, the junior doctors, nurses and allied health professionals. Interprofessional ward rounds took place at least twice a week, input was sought from all members of the team. Over confident young pharmacists were supported rather than blamed when they missed important interactions (a key aspect of Mendenhall's highly effective teams) (168); and there was also enough cross monitoring for young pharmacist to learn that DMARDs were an unsuitable treatment for ankylosing spondylitis from a physiotherapist – although I didn't realise it at the time this was a paradigm experience (97).

Unfortunately the time came for me to move on in my rotation and I quickly tired of the politics and restrictions of hospital pharmacy. I found myself subverting some of the unnecessary rules and regulations because I liked to think about what I was doing. Soon a team of six band 6 pharmacists became 1 and the resultant workload became untenable and frankly unsafe. A job offer from community pharmacy came my way and I gladly took the way out.

Community pharmacy was a revelation in terms of independence and autonomy, although it produced another set of challenges. Primary care meant the contact I previously enjoyed with doctors became less frequent and often facilitated by telephone calls. I struck up a good working relationship with a local physiotherapist where we cross referred patients with musculoskeletal problems and sports injuries to each other. Again I was very interested in his knowledge of anatomy and how he diagnosed patients via physical manipulations.

Having had the idea as a young pharmacist that I wanted to be a teacher-practitioner and getting a little bored in the world of community pharmacy I applied for a job at Keele University. Fairly early on in this position I noticed I tended to teach in a different manner to my colleagues, focusing on active and pragmatic theories of teaching I often brought props into my teaching session and compared difficult physiological and pharmacological problems to everyday occurrences. This 'difference' to the norm often led me to question my chosen career; if the pharmacy profession did not value my skill set, was I really doing the right thing? This manifested itself in numerous ways with thoughts of retraining as a doctor and a physiotherapist sitting uncomfortably alongside a broadening of my horizons beyond teaching pharmacy students alone.

With very little knowledge of the unpinning theory of IPE one of my first teaching ventures with colleagues from outside the School of Pharmacy was a session entitled "Physio-Pharmacy IPE". Based on my experiences of working with physiotherapy colleagues in practice, I co-designed my first IPE event with my good friend Anne O'Brien from the School of Physiotherapy. I felt that final year undergraduates in both disciplines had much to learn from one another, and a case based PBL session based on musculoskeletal medicine was designed which encouraged students to develop shared care plans for their patients. The initial feedback included quotes such as: "*This is the best IPE I have ever done."* Almost ten years later, I still learn something new in each iteration of this session. This practical approach to IPE, showing one group the value of the other; and allowing each group to teach the other both has collaborative and affirmatory outcomes. Student knowledge of others' values and working practises increases alongside student confidence in one's own practise. This reinforced my belief in the necessity of IPE.

Following completion of my PG Certificate in Higher Education, I accepted a full-time position at University on the proviso that I would complete a PhD. I chose a PhD as opposed to a professional doctorate because I wanted a qualification which would transcend my own profession. Being the atypical pharmacist I am I wanted to conduct my study in an area which would expand my horizons rather than limit them. Interprofessional education seemed like the perfect opportunity to do this. Professional bodies in 2012 were becoming more forceful with their endorsements of IPE; alongside this interest in IPE research was expanding. At the same time I became faculty lead for the IPE2 programme; a one month IPE module delivered to second year students from nursing, midwifery, medicine, pharmacy and physiotherapy. Student evaluation of this programme was somewhat mixed; I thought at the time this was due to the absence of explicit learning objectives asking students to teach each other skills. Seven years' experience has taught me this is not the case; the actual truth is much more complex, but is rooted in the scepticism of classroom based learning from nursing students and the lack of clinical knowledge associated with second year study amongst medical and pharmacy students.

Wanting to solve the age-old difficulty in timetabling shared learning experiences; I identified that the virtual patient technology already in use in the Keele School of Pharmacy had potential to be delivered on a mobile platform. Simulated educational experiences were becoming commonplace in the schools of nursing and medicine and I believed this method of learning could be adapted for pharmacy students. My experience in teaching IPE allowed me to see that pharmacy students suffered from their lack of clinical experience in their undergraduate study.

As I enjoyed solving practical challenges as opposed to pure research I threw myself into the design and evaluation of a virtual patient simulation which could be used to deliver IPE experiences. With the power of seven years of hindsight I now realise this was somewhat overambitious, and probably beyond the remit of one PhD thesis. Taking into account Anthony H. Wilson's definition of praxis 'as doing things and then learning why you did them later' I can now say I have some expertise in IPE, clinical simulation, virtual patients and behavioural psychology. Certainly I think I avoided my worst fear when starting the PhD: that I would know more and more about less and less.

Thus my interest in this particular research project stems from my general dissatisfaction with the cultural norms passed down to me by hospital and community pharmacy. The satisfying part of my previous career had always taken place in the company of other healthcare professionals rather than with pharmacists alone. My paradigm experiences of learning from other professions and my realisation that we all have something to teach each other; turned me into an advocate and a champion for IPE. An honest acknowledgment of the difficulties in scheduling IPE, led me to believe that mobile technology may hold a solution which negated these difficulties. Observation of undergraduate pharmacy students In IPE events; demonstrated that they were hampered by their lack of exposure to experiential learning. Simulation would provide an opportunity for them to increase their clinical knowledge and competency.

An experienced professor in pharmacy education once told me that the best ideas often come from speaking to others, and adapting their methods. With this in mind I decided to combine the fields of mobile technology and simulated virtual patients to deliver an IPE intervention. At the time my passion for the subject matter exceeded my competency; the project threw up many challenges which I did not envisage. Perhaps now having made many mistakes in the field, I can claim to be competent in the design and delivery of interprofessional clinical simulation.

CHAPTER 2 - METHODOLOGY AND METHODS

2.1 Aims and Objectives

Aim

Design and evaluate a real-time virtual patient simulation for interprofessional education

Objectives

Investigate if the simulation facilitates undergraduate healthcare students to learn from, with and about each other.

Establish if the simulation facilitates interprofessional communication between differing student professional groups.

Identify professional culture traits and collaborative behaviours mediated by the simulation; verify why each professional group exhibits these traits and behaviours.

Assess the psychology influencing student behaviour and team work in interprofessional education.

Judge if real-time virtual patient simulation is educationally beneficial, and compare and contrast its' merits to other established methods of delivering interprofessional education.

2.2 Methodology

2.2.1 Aims and Introduction to Methodology

The central aim of the study is to assess participant views on the educational benefits of a new mode of delivering interprofessional education. It is worth reiterating the definition of IPE (from the Centre for Advancement of Interprofessional Education, CAIPE) before continuing as this defines the key methodological paradigms underpinning the research:

"Where two or more professions come together to learn, with, from and about each other." (169)

Numerous research papers often conflate methodology and method (170). Methodology concerns the central philosophical arguments and theoretical analysis associated with a branch of knowledge. This covers paradigms, theoretical models and quantitative or qualitative approaches. Method involves the practical tasks conducted in order to generate knowledge.

Paradigms of research have been grouped into various different headings such as positivist, post-positivist, constructivist-interpretivist and socio-critical paradigms (Table 2.1) (171,172). These paradigms overlap and can be divided into traditional positivist approaches (designing research to test hypotheses), based on empirical scientific views of knowledge; and post-positivist approaches (generating hypotheses) which include constructivism and socio-critical approaches (171). The choice of methodology depends on a researcher's view of four axioms or principles which underpin his view of the world. These are: epistemology (what counts as knowledge), ontology (the nature of existence in relation to the study), axiology (the fundamental values of the researcher and their relationship with the research and its' subjects) and logic or rhetoric (what is acceptable rigour when it comes to defining arguments).

2.2.2 Defining the Paradigms of Research

Overarching Paradigm	Positivist	Post-Positivist		
Subclasses	Positivist	"True" Post-positivist	Constructivist-Interpretivist	Socio-critical Power

Table 2.1 An overview of differing research paradigms

The Positivist Paradigm

The positivist paradigm concludes that the only way people can be positive that something is true, is if it was created using scientific method (derived from experimentation and observation)(171). The positivist approach involves suggesting hypotheses and then designing experiments to prove/disprove them. With respect to epistemology and ontology positivists claim there is "one truth" which is waiting to be discovered via the scientific method; and that facts are facts, there is no room for interpretation. The axiology of the positivist paradigm involves the researcher being values neutral, and as distant from knowledge generation as possible, there is no place for bias, values or feelings to be included as part of any knowledge generated. The logic and rhetoric of the positivist stance is concerned with prediction, control and explanation. Findings are always explained in an objective manner, with emotional detachment. A wide range of statistical measures are used to test rigour and validity of these studies.

Post-Positivist Paradigms

The empirical scientific approach held sway until researchers such as Thomas Kuhn and Karl Popper started to challenge the scientific community in the 1960s to think about knowledge in other ways. Post-positivism (so called as it followed the positivist paradigm) acknowledges that there are many ways of knowing apart from the scientific method, and generates rather than tests hypotheses. Ponterotto (2005) splits post-positivist methodologies into three distinct paradigms, whereas other authors including McGregor and Murnane (2010) view the constructivist and socio-cultural methodologies as differing aspects of an overarching post-positivist paradigm (171,172). According to Ponterotto the "true" post-positivists would view ontology in a similar manner to the positivist in that there was still one true reality, however their concession is that human mechanisms of defining this reality are flawed and that one will never really capture all of the truth. With regard to epistemology a post-positivist would acknowledge that as a researcher they may influence their participants and vice-versa, however this should be kept to a minimum and the researcher should remain as objective as possible. The use of standardised research methods in a post-positivist methodology enables the researcher to strictly control any influence they may have on the process, thus values should not overtly influence the axiology and rhetorical nature of a post-positivist study.

Constructivist-Interpretive Approach

The line between this approach and that of the post-positivist may be somewhat blurred, however the axioms underpinning the constructivist approach offer radical alternatives to scientific method. Epistemologically the constructivist approach asserts that knowledge is constructed by people, and thus there is more than one created truth, the truth is subjective and may be interpreted in differing ways. The dynamic interaction between researcher and participant is central to capturing the lived experience or *Erlebnis* of a participant. On an ontological level it is more practical than the positivist approach accepting that ethnic, cultural, social and political values have a bearing on a persons' perception of reality, and accepting that reality is constructed collectively with others. With respect to axiology a constructivist standpoint aims to uncover the beliefs and customs that shape human behaviour. Bias feelings and hopes are central findings, and a researcher's *Erlebnis* cannot be separated from the process. The logic behind this type of research is concerned with how people make sense of their world and attempting to find various interpretations of reality, the researcher's own values, biases and expectations should be detailed comprehensively.

Socio-Critical Power Approach

The socio-critical approach aims to emancipate research participants by critically questioning "the way things have always been done"(171). The goal epistemologically often is to incite transformation in the participants, basing knowledge on material fact (the way things are) which is subject to change based on who holds the power in society. The ontology of this paradigm is based in the present, shaped by ethnic, cultural and political values and mediated by power relations. It seeks to truly understand the real circumstances of a situation and change the power balance. Criticalists actively hope their biases and values will influence the research process, an integral goal of the research is to empower participants to transform their reality (172). The logic behind the critical method is to reveal power relationships and to alleviate oppression amongst participants.

2.2.3 A Methodology for Testing a Novel Intervention in Interprofessional Education

Interprofessional Education is defined as "when two or more professions come together to learn with, from and about each other".   The majority of previous research in this field has used standardised, validated tools in order to minimise any influence the researcher may have on the process (64,79,84), it is firmly rooted in the positivist and post-positivist paradigms where the researcher attempts to quantify reality and strictly controls any influence they have over an outcome. Olson and Bialocerkowski (2014) state that IPE is the centre of an epistemological struggle between positivist paradigms from healthcare science and educational theory. They argue that the positivist paradigm is inappropriate for IPE and state the need for more qualitative studies into the effects of IPE (90).

As IPE aims to facilitate "learning from one another" from an epistemological viewpoint, participant opinion and how they react to the intervention is critical to the research. The separate professions are likely to have differing standpoints on the intervention, and despite being exposed to the same reality how they interpret what has happened to them is crucial data for the research. In fact if they construct differing opinions on what has happened and the interactions facilitated by these differing realities provoke conflict, it will be a key finding. Therefore epistemologically speaking the research belongs to the constructivist-interpretative paradigm. An argument against this is that constructivists tend to advocate that the dynamic reaction between researcher and subject is of vital importance to any findings. In the case of this research the influence of the researcher is of secondary importance to the interaction between participants. This more closely resembles a post-positivist stance where a researcher acknowledges they can have an influence on the knowledge produced, but attempts to correct any bias caused by it. Thus the epistemology of this research project lies in the grey area between post-positivist and constructivist-interpretivist paradigms.

On an ontoglogical level, the positivist and post-positivist standpoint that there is one true reality which is either fully or partly measurable is inappropriate. Again a constructivist paradigm where reality is subject to the individual's perception, the social environment and the interaction between participant and researcher creating "multiple realities" best fits the project.

Axiology concerns the role of researcher values on the process (172). As the researcher is an advocate of IPE, there is certainly a chance of his values being introduced to the process. In a constructivist approach participants play a pivotal role in research even instigating it; bias, feelings, hopes, and expectations are central to the research outcomes. In terms of “learning from with and about each other” feelings, hopes and expectations are central themes to discuss. A positivist and post-positivist approach would carefully control these biases and has certainly been attempted in previous studies (64,79,83), however for this piece of work a more interpretive approach to axiology is required.

In terms of logic and rhetoric, the research will rely on recognising patterns of behaviour and opinions which determine how the intervention affects relationships between the participants. Ascertaining their “lived experience” of the intervention and previous formats of IPE will be critical to the findings of the study. Again this stems from a post-positive constructivist paradigm.

Ponterotto acknowledged that strong qualitative research can emanate from multiple paradigms. The paradigm for this research certainly falls into what McGregor and Murnane would refer to as post-positivist, with leanings towards constructivism in terms of epistemology and ontology (171). In short this research is interested in what people think, how they think and why they think in that manner (173) the methods used will be compatible with post positivist and constructivist methodologoical approaches. Post-positivist methods will allow for comparison to previous studies whereas constructivist methodologies will allow for greater depth of communication both with and between the subjects.

2.3 Benefits and Drawbacks of Research Techniques

2.3.1 Introduction

Interprofessional Education (IPE) has been postulated as a mechanism to improve collaboration in the healthcare workforce (174), surrogate benefits of this are expected to be the reduction of professional stereotypes and the improvement of patient safety. However, there are very few studies that demonstrate that IPE makes a difference to teamwork in practice (62). Most IPE studies report findings using student self-reported questionnaires, which show attitudes towards and preconceptions regarding other professional groups and their readiness to collaborate with others. Due to the complexity of interventions and confounding factors between undergraduate education sessions and the actual practice of a given professional, it is extremely difficult to demonstrate patient benefit from IPE. It has been noted that poorly designed IPE has the potential to exaggerate stereotyping between professions and negatively impact on future working relationships (175).

2.3.2 Research Methods

This project aims to generate rather than test hypotheses and belongs to a post-positivist, constructivist paradigm. As such a number of data collection methods may be employed to generate data. These stem from the basic tenets of research into education, interprofessional education, mobile learning, computer programme design, social science and gamification of education. The majority of previous studies into IPE have used quantitative questionnaires in order to elicit results, for this research a mixed methods approach has been taken focusing on qualitative data as recommended by Olson and Bialocerkowski (90) is essential but using a validated quantitative tool allows for comparison to previously published research.

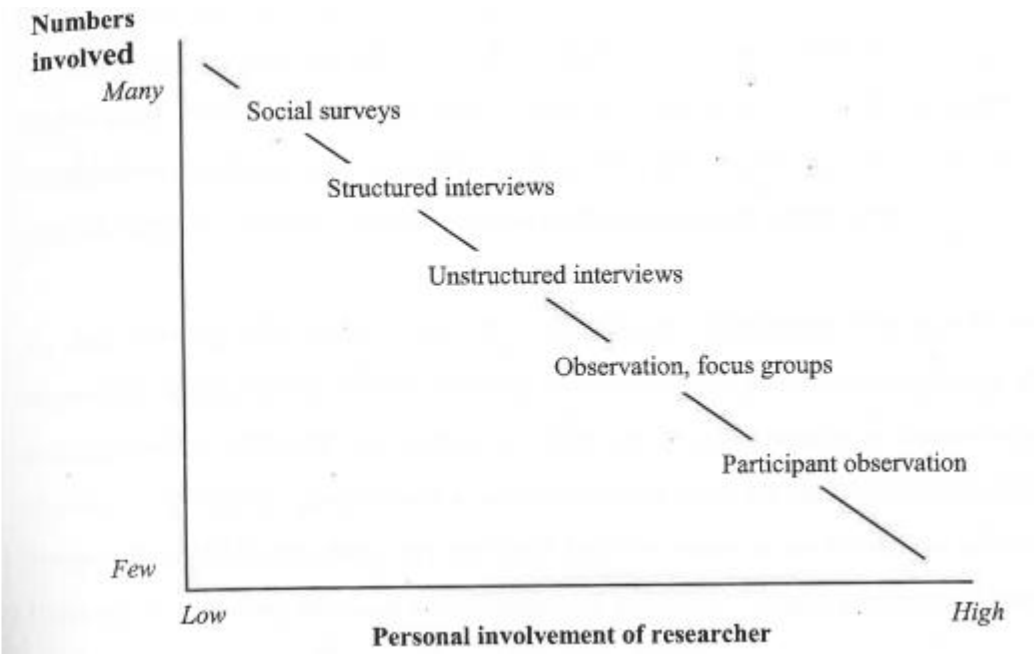


Figure 2.1 Relationship between research technique, personal involvement and the number of participants (Worsley 1997; as cited in Maddock 2009 (176).

There are many techniques available for collecting data in health and educational research, each with it's own particular set of strengths and weaknesses; Figure 2.1 shows the relationship between the personal involvement of the researcher and the number of participants required for research.

Questionnaires: advantages, disadvantages, relationship to literature

The majority of interventions in the field of IPE use questionnaires as their primary method of data collection (63,88,177). These include but are not limited to tools such the Readiness for Interprofessional Learning Scale (RIPLS) (178), the interdisciplinary education perception scale (IEPS) (179) and the University of the West of England Interprofessional Questionnaire (UWE-IPQ) (84). Often these questionnaires are used in a pre-test, post-test format and then analysed for changes following an IPE intervention. Questionnaires allow for a large variety of data to be collected from a large cohort in a relatively short space of time. They are cheap to administer, save time at the point of data collection, are reproducible and can be administered via a variety of media such as postal, internet, telephone and face to face.

Structured interviews or face to face questionnaires are often prohibitively costly due to transport arrangements and the cost of a researcher's own time. Postal questionnaires were until recently considered to be cheap, easy to administer and ideal for delivery to a wide variety of participants in a large geographical area. The advent of the internet and email based services means that postal questionnaires may now be considered more archaic, although their use is not entirely irrelevant. Internet based questionnaire design tools such as survey monkey allow for the 'free' design of questionnaires which do not incur postal and printing expenses. These programmes often allow for near instantaneous data analysis and the quick generation of inferential statistics.

Internet and postal questionnaires have one major drawback: response rate. A typical response rate for a postal questionnaire has been found to be between 30-40% (180), for internet questionnaires figures as low as 12.5% have been reported (181). This is thought to be due to the absence of personal communication and human interaction in the delivery of an internet survey. Non-responders may produce a problem in their own right, with the introduction of unintentional bias. Non-responders may have a common reason for their lack of participation, which will never be ascertained by questionnaire research. Another drawback of questionnaires is that they can be difficult to design (182) and careful thought has to be given to how the questionnaires are to be analysed at the design stage, otherwise returns may be impossible to deal with. A further drawback levied against questionnaires is that participants may misunderstand basic concepts or terms within the questionnaire itself; and the researcher has no opportunity to correct those misconceptions, thus rendering responses less useful (183).

Oppenheim (182) suggests that questionnaires should consist of a logical series of question sequences or *modules*, each designed to investigate a specific aspect of the broader research question. Modules regarding personal data such as age, gender or profession should be left to the end of a questionnaire in order to maximise the response rate. Some participants may find requests for personal data threatening therefore placing these questions at the end of a questionnaire may reduce the impact of these queries on the participant and thus improve response rate.

Questionnaires may contain open and closed questions. Closed questions allow the researcher to control the responses of participants to a certain degree, allowing for comparable quantitative data to be derived. Closed questions may involve dichotomous scales where two responses may be elicited (e.g. yes/no). Multiple category questions provide three or more answers to participants with answers which are completely independent of each other. Both dichotomous and multiple answer questions produce nominal data.

If a researcher wishes to explore deeper levels of feeling, attitudes, or strength of opinion; rating scale type questions may be employed within a questionnaire. Rating scales tend to allow participants to express opinions based on different polar responses (e.g. positive/negative, low to high, weak to strong). As participant responses are scaled towards an order of magnitude they produce ordinal data and means and standard deviations may be calculated. Care must be taken when interpreting data from rating scale questions as the intention and thought process behind the response 'strongly agree' may vary widely between participants.

Rating scales may be produced in a number of formats, one of the most widely used is the Likert scale, originally devised in 1932 (184). Likert type questions ask a participant to rate the strength of their agreement/disagreement with a statement. They can consist of any number of categories with 5 being the most commonly used. Recent developments in educational research have advocated using even-numbered Likert scales (e.g. 4 or 6) in order to eliminate a default position of neutrality amongst participants(185).

Data from Likert type questions can be interpreted by the use of scoring systems, with two methods outlined in Table 2.2 below:

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5
-2	-1	0	+1	+2

Table 2.2 Example scoring systems for Likert-type questions

If a neutral point is used in a scale then the second scoring system is superior as it adequately reflects the neutral status of the participant. Using a 1 to 5 scale with a score of 3 would imply a lesser degree of agreement than 4.

Other rating scales commonly used in health sciences include the visual analogue scale (VAS). These typically consist of a 10cm straight line where participants are asked to mark their strength of agreement between two extreme points of view. The line is divided into ten 1cm segments by the researcher and the response scored on the basis of where the participants mark lies. These scales are often used to assess pain severity in patients with chronic illness e.g the DAS28 score used in diagnosis and management of rheumatoid arthritis (186). Again the data derived from VAS scales is subjective as one patient's perception of the severity of pain may be very different to another; and indeed the patient themselves may perceive the same pain differently at two differing points in time.

Other common questionnaire question types include ranking questions where participants may be asked to rank concepts in order of preference and category questions where a participant may only pick one response from a selection (e.g the age categories of 20-29, 20-39 etc).

Open questions may also be used within questionnaires although the serendipitous nature of responses may result in difficulties in analysis. Well-structured questions may circumvent this problem.

A report by the Canadian Interprofessional Health Collaborative found 128 unique tools for collecting quantitative data from 136 IPE manuscripts (187). The most commonly used tools were the Readiness for Interprofessional Learning Scale (RIPLS), the Interdisciplinary Education Perception Scales (IEPS), and the University of the West of England Interprofessional Questionnaire (UWE-IPQ). These are readily available validated tools and as such provide comparable, reliable and relevant data. Papers often reported on differences in responses pre and post intervention. RIPLS is the most widely used tool, however the questions are targeting a students' *readiness* for IPE, rather than their opinions of any intervention.

As all the participants in this study will be volunteers it can be postulated that they all will have a positive predisposition to IPE, and thus RIPLS would not elicit discriminating information from the participants, and any changes in response following an intervention would be minimal.

The UWE-IPQ (IIQ, intermediate interprofessional questionnaire) (84) consists of 35 open questions which collect demographic data, and assesses students on four scales which would correspond to the *modules* proposed by Oppenheim (182). The scales assess a students' perception of communication and teamwork, interprofessional learning, interprofessional interaction and interprofessional relationships. It was previously been trialled on a large cohort of healthcare students, and was found to be internally consistent at two week intervals in a control group and comparable to results obtained from administering the IEPS to a cohort of students (84), thus expressing internal and external validity of the tool (188).

Olson and Bialocerkowski (2014) argue that IPE research requires more qualitative studies which focus on interprofessional socialisation, as opposed to quantitative tools measuring educational improvement or attempting to measure attitudinal change (90). The original authors of RIPLS acknowledge it was not useful for measuring attitudinal change. To uncover underlying behaviours and assumptions of healthcare professionals and students with regards to IPE; it is necessary to use research techniques with greater personal involvement such as observation and focus groups.

Interviews

Interviews are a commonly used technique in qualitative research; they offer advantages over surveys and questionnaires as they allow a researcher to probe participants as to why they feel a certain way. In short they can explore attitudes, feelings, experience, knowledge and background information. Interviews can be divided into three major classes: structured, semi-structured and guide or depth interviews. The latter are often referred to as unstructured interviews (183,189).

Structured interviews are often considered as anomalous to face to face questionnaires. Researchers will read closed questions verbatim to a participant and fill in a pre-prepared answer sheet. This technique will yield quantitative data.

Semi structured interviews are conducted with the help of a loose structure or topic guide which may consist of open questions which define the area to be initially explored by the participant and interviewer. The interviewer or interviewee has license to diverge from this guide at any time in order to pursue an idea in more detail.

Unstructured interviews are something of a misnomer, as no interview is entirely lacking in structure. Of central importance in this technique is the freedom for respondents to talk about subjects of importance to them rather than the researcher. Depth interviews may only cover one or two subjects, but do so in a much more comprehensive manner. A loose structure is required in order to ensure that important subject matters are covered, and a framework is established for the interview but no questions are actually defined, hence the term guided interview (183,189,190).

An advantage of the interview is its' adaptability; semi-structured and unstructured interviews can elicit data impossible to garner from structured interviews and questionnaires. The ability to probe participants allows for the generation of new hypotheses and new lines of enquiry. Participants in a one on one interview may feel more comfortable to share their views than they would in a focus group, as there is no fear of reprisals or disapproval from peers. This may be important for research into IPE as the multiprofessional nature of the focus groups may cause one personality or one profession to dominate proceedings; resulting in another profession or individual being fearful of expressing views to the contrary.

Focus Groups - advantages and disadvantages

Focus groups allow for the collection of a relatively large amount of data in a short timeframe and explore attitudes, perceptions and feelings amongst a small group of people. The group setting provides some security for individuals who may otherwise feel intimidated by a researcher or feel vulnerable to criticism. Conversely other individuals may feel more comfortable speaking to a researcher on a one on one basis.

Focus groups excel as a data collection tool, where it comes to investigating why participants think as they do as opposed to what they think (191). Measuring individual attitudes in a focus group is at best misguided, however this is often cited as a frustration by researchers. It must be remembered that the somewhat contrived nature of a focus group may lead participants to perform somewhat unnaturally by taking on a role they think the researcher wants; or by performing as a stereotype or caricature of themselves (192).

Focus groups must never be used a fact finding exercises as the ‘truth’ is often relative for participants, which is of great interest to research under the umbrella of the constructivist paradigm. Close analysis of focus group discussion almost always results in inconsistencies and contradictions which add colour to the data (193). Other criticisms of focus groups include the possibility that participants are just telling the researcher what they think they want to hear, although this charge can also be levied against interviews. Focus groups are also complicated by the fear of peer group disapproval (194).

Wilson (195) states that while focus groups may not reveal the same information as private interviews they do reveal what participants are willing to elaborate and defend in front of their peers.

Researchers often cite that they employ focus groups when one on one interviews may be too time consuming. This negates the strengths of both focus groups and interviews. Even allowing for the observed tendency for focus groups to end in a consensus (196) it is hugely unlikely that all participants will agree from the outset. The researcher must focus on the process in order to gain the most valuable data rather than the outcome of a focus group.

Mixed Methods

A focus group with an enthusiastic or overly zealous individual is likely to stimulate debate, but the downside of this is that those with opinions who are more moderate or less well-informed may feel intimidated to express their opinions in such a situation. One solution for this could be the use of the mixed methods approach. The use of interviews alongside a focus group may allow less confident individuals to clearly express their views, whilst offering another angle on the same situation. A mixture of quantitative and qualitative approaches has often been used in health sciences research (197) with qualitative research furnishing explanations for the results of quantitative research. Pollack (198) suggests that the mixed methods approach is most appropriate in cross-cultural research, and in research where there are clear power relationships between participants. This can easily be extrapolated to the field of IPE.

Observational Data

Questionnaires, interviews and focus groups may provide important information but they only reveal how people perceive a situation, as opposed to objectively describing what happened (199). Observational data is useful for determining whether or not people behave in the manner which they say they do. Observation can reveal characteristics of group dynamic which are difficult to elicit using other methods of research such as focus groups. Each person perceives the world through their own personal values and cultural background. If three people are asked to observe an interaction for five minutes and then summarise their findings it is likely that they will produce three differing accounts of the events.

As observers constantly filter material obtained from an event, it is easy to impose one's own views on the material and thus fail to understand what an activity means to those involved in it. Any observational study needs to acknowledge this risk and eliminate preconceived ideas and prejudices thus keeping potential bias to a minimum. As IPE aims to improve collaboration and reduce stereotypical power relationships, amongst a diverse group of healthcare students, observation of their interactions with each other and the application will provide interesting information.

Research observation may be divided into four main classes: unstructured or structured; and participant or non-participant.

Structured observation involves a researcher pre-determining the focus of the study rather than allowing a focus to emerge from the interactions. It often incorporates the use of an observation schedule in order to eliminate variation between different observers (200).

Unstructured observation tends to lend itself to situations where researchers have a clear purpose for observation but a nebulous view of what will actually occur. In unstructured observations the researcher must not pre-determine classifications, but observe in a more laissez-faire manner, waiting for the themes to emerge from the research in a similar manner to grounded theory (201), thus unstructured observations lend themselves to generating hypotheses (202).

Participant observation involves the researcher becoming embedded within a community or social setting which they wish to study. Researchers may spend months or years with a community in order to be viewed as part of the group. Criticisms of this style of research often stem from the risks of "going native" and failing to eliminate bias, subjectivity and impressions from the research. Denscombe (200) also sounds a warning regarding the difficulties of consent with this type of research; if a researcher is undercover then informed consent to participate is almost impossible to garner. The advantage of participant observation lies in the fact that a researcher spends a sustained period of time with a group, this allows for a more rounded picture of any hierarchies and social constructs to emerge, and may reveal facts which would be impossible to ascertain from one-off interventions. The ability to share in the lives of other people and understand their views of the world should not be underestimated (203).

Observational data will be used in this study to gain an impartial insight into the relationships between students mediated by the intervention. A well designed simulation will hopefully negate any hierarchical relationships between medical students and other healthcare students. In order to reduce any prejudice the researcher may have as a pharmacist and as a researcher into IPE, an independent observer independent of the healthcare professions will be recruited. The observer will be blinded to student affiliation and will conduct the observation in an unstructured, non-participant manner in order to provide a secondary view of the interaction mediated by the application.

2.4 Methods

2.4.1 Establishing Simulation Design Principles

Students from nursing, medicine and pharmacy were selected as participants modelling the two most frequently encountered healthcare professionals worldwide; alongside the native profession of the lead researcher.

To involve pharmacy students adequately the simulation was deigned to take place in the sub-acute setting of a hospital ward, following the journey of a patient with chronic obstructive pulmonary disease (COPD). COPD was chosen as it is a very common disease state to which all students had prior exposure and experience. Appropriate treatment required an adequate dose of oxygen for a carbon dioxide retaining patient; and a reasonable choice of antibiotic for a patient with COPD and a penicillin allergy. This would stabilise the patient for two days, after which the virtual patient would begin to deteriorate again. At this stage participants would have to prescribe a treatment choice outside of NICE guidance (aminophylline infusion) in order to successfully treat the patient.

A design brief using a virtual patient avatar was drafted. Based upon this brief an avatar (Figure 2.2) was designed and built by an animation and programming team using Unity (2017.1), a cross-platform game engine which can be used to develop two and three-dimensional simulations for desktop computers, and mobile devices using virtual or augmented reality technology.

Figure 2.2 The virtual patient "Bertie"

In order to facilitate this process three models were considered to design the simulation: a matrix, a linear storyboard and a peripheral complexity model. The original design format was a matrix, which involved modelling blood test results and patient outputs to input provided by the user. Early in the process it was decided that this model was too complex to provide a practical design solution. Thus two further models, a linear storyboard model and a peripheral complexity model, were considered. A linear storyboard model involves a series of sequential defined steps and was deemed insufficiently flexible to reflect the reality of even a simple clinical case. A peripheral complexity model involves a simplified scenario working in the background of the simulation whilst maintaining a veneer of reality. Participants would be able to undertake numerous observations, examinations, order blood work and prescribe medication for their patient; however only a few of these inputs and outputs were dynamically modelled to update in real time. For instance a participant may choose to prescribe a beta antagonist or digoxin to reduce the heart rate of the virtual patient, however this will have no effect on the algorithm running the software (Figure 2.3).

Figure 2.3 Visual representation of the peripheral complexity model.

The design allowed participants to interact with the virtual patient (VP) in a number of different ways: real-time updated vital signs were permanently available via a screen called the 'ECG', physical examinations i.e. chest auscultation could be undertaken and provided feedback via text, sound and visual means where appropriate (Figure 2.4). Participants could ask pre-defined questions to the patient, answers would vary dependent on the vital signs modelled by the VP. Laboratory tests could be ordered with results becoming available after a set time mimicking the reality of having to wait for information. Students could prescribe drugs for the VP, which would then appear via an e-prescribing interface (Figure 2.5) and a note making facility was provided to allow students to record what they did at a given time. Time control functions were also available to participants. The default setting of the simulation was to play out in real time (where one minute=one minute), however participants had the option to fast forward time at two speeds, to skip forward one hour or to pause the scenario where they felt necessary.

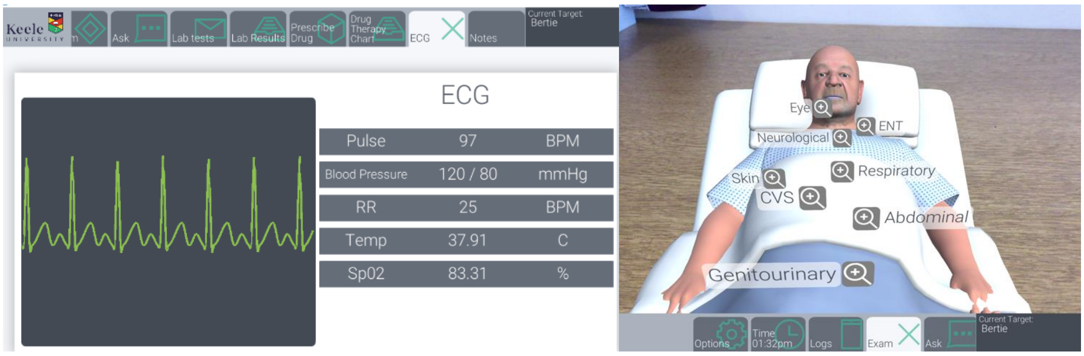


Figure 2.4 Screen shots of the simulation showing the 'ECG' and 'examine patient' screens

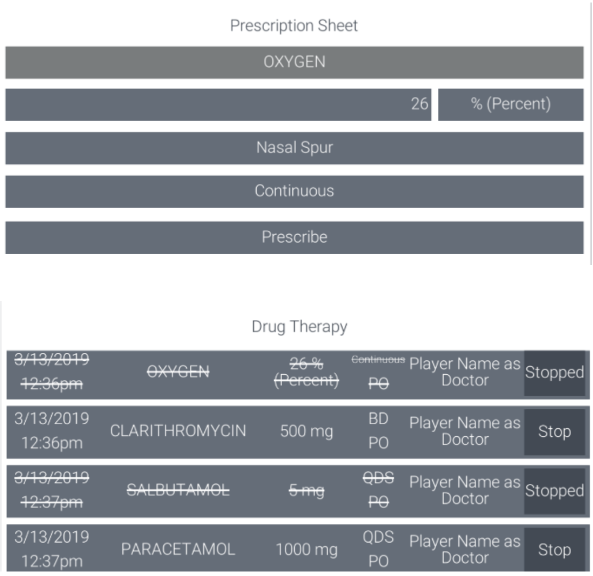


Figure 2.5 Screen shots of the 'prescribe drug' and 'drug therapy' screens within the simulation

The design of the simulation involved significant input both from the lead researcher as the clinical lead and a design team involving two computer programmers, a project manager and two virtual patient animators. Many technical challenges were overcome by good communication and collaboration and a lot of hard work from all members of the team.

2.4.2 Recruitment

Ethical approval was granted from the Keele University Research Ethics Committee (ERP2308 – Appendix 1). Key contacts from the Schools of Medicine, Nursing and Midwifery, Health and

Rehabilitation (for physiotherapy lecturers) and Pharmacy were invited by the lead researcher (JD Berry) to take part in the initial lecturer evaluation. These contacts were then used to recruit volunteer students for phase 1 (n=8) from each of the schools of medicine, nursing and pharmacy. Recruitment from the medical school was particularly challenging with a reluctance from lecturers to expose medical students to educational research.

The second phase of the study required an extension to the original timeframe for field work which was granted in December 2017. Key contacts were used once again to invite students to volunteer for the study. Initial methods used to recruit students included generic emails to year groups (Appendix 2), and appeals to key contacts in the nursing and medical schools e.g. year leads. Resistance from lecturers with respect to advertising educational experiences for their students was noted in both the schools of medicine and nursing. The key contact in nursing managed to negate this, with six volunteers from nursing committing to events. The medical school proved to be somewhat more challenging, with generic emails being stymied. When this strategy failed personal invitations to students, face to face contact with the Head of the Medical School and presentations at medical student events were attempted. This resulted in approximately six student volunteers from the School of Medicine committing to events. The next difficulty was attrition, especially amongst medical students as many were lost to follow up. An alternative lecturer contact at the University of Manchester was approached to seek medical student volunteers, this contact was enthusiastic regarding the simulation, however when he approached a colleague in charge of third year medical students, no response was forthcoming. Eventually with the help of some inducement (in the form of monetary compensation for time) five nursing students and one medical student and nineteen pharmacy students took part in phase two.

2.4.3 Data Collection

Data collection followed the constructivist paradigm referred to in the methodology chapter. Qualitative data was gathered from all participants by means of independent observation of their behaviour during the simulation and their responses in focus groups following the simulation. The overall study can be divided into two major phases: phase 1 and phase 2 (Figure 2.6).

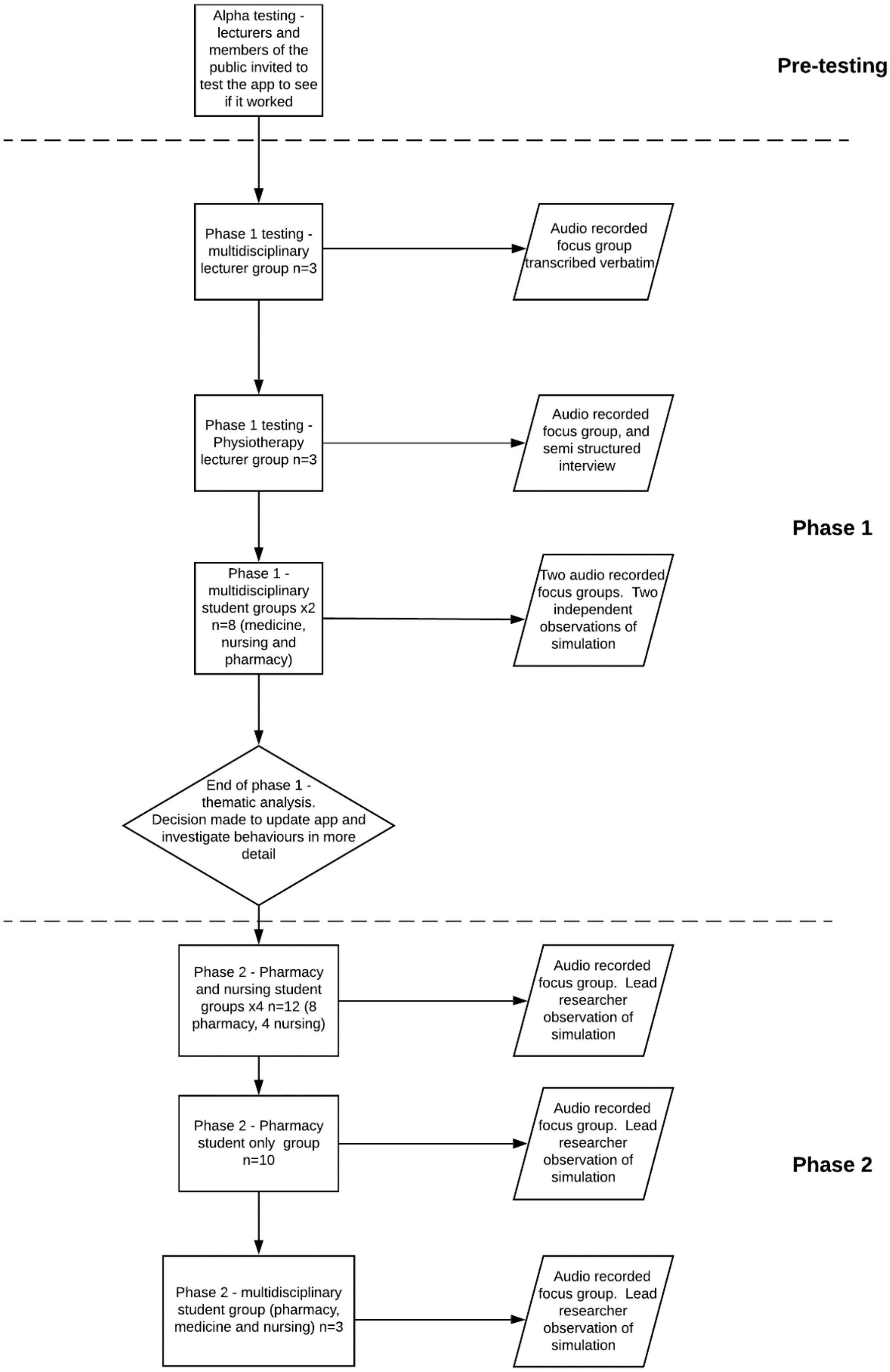


Figure 2.6 Summary of the data collection methods used in the study

In phase 1 the prototype application was initially tested by the clinical authors, and then beta-tested by a group of clinical lecturers (n=3 from medicine, nursing and pharmacy). Following the initial beta test a focus group de-brief was conducted, audio recorded and transcribed verbatim. After the initial beta-testing the simulation was tested by a group of physiotherapy lecturers (n=3); again this was followed by a focus group which was transcribed verbatim; one participant had to leave prior to the focus group taking place and was followed up with a semi structured interview.

Flaws in the technology were identified during this initial part of the study and were corrected prior to administration to student groups. The final stage of phase 1 involved the recruitment of eight volunteers from stage 3 medicine and nursing and stage 4 pharmacy. These students were randomised into two groups (n=3 and n=5) who participated in the simulation in a teaching room enabled with a wifi connection at Keele University School of Pharmacy.

Students were asked to read participant information sheets (Appendix 3) and gave written consent (Appendix 4) prior to taking part in the simulation. Students were then asked to introduce themselves to each other and were briefed by the lead researcher regarding what would be expected of them within the simulation, and how they could interact with the technology. In phase 1 a written brief in the form of a GP referral to hospital (Appendix 5) was provided to students prior to commencing the simulation. An independent observer was recruited from the school of psychology to observe student interaction and behavioural patterns during the simulation. The observer had no written brief, and no knowledge of the background of participants, thus this could be considered to be unstructured observation of behaviour. The observer sat in the teaching room for the duration of the simulation, and made hand written notes on student behaviour and interactions. During the simulation each student group was provided with one iPad to deliver the virtual patient simulation. The app for delivering the simulation had previously been downloaded onto the iPad, however a wifi connection was necessary to maintain connectivity. Following the simulation, participants were de-briefed by the lead researcher and a focus group was conducted to gather their thoughts regarding the educational, communicative and behavioural aspects of the simulation (Appendix 6). These focus groups were again audio recorded and transcribed verbatim; observational notes from the independent observer were also added to the data set. This concluded the data collection for phase 1 of the study, all transcripts were printed and analysed according to Braun and Clarke's method of thematic analysis by the lead researcher (204). A summary of the lecturer and student volunteers, and any observers and facilitators in the learning events can be seen in Figure 2.7 below.

Event 1 – Interprofessional Lecturers

Code	Background	Role	Facilitator	Observer
NL01	Nurse	Nurse	Lead Researcher (JB, pharmacist)	N/A
PL01	Pharmacist	Pharmacist		
DL01	Doctor	Doctor		

Event 2- Physiotherapy Lecturers

Code	Background	Role	Facilitator	Observer
PY01	Cardiorespiratory Physiotherapist	Cardiorespiratory Physiotherapist	Lead Researcher (JB, pharmacist)	N/A
PY02	Cardiorespiratory Physiotherapist	Cardiorespiratory Physiotherapist		
PY03*	Cardiorespiratory Physiotherapist	Cardiorespiratory Physiotherapist		

*PY03 was followed up with a semi-structured interview due to time constraints

Event 3 – Student Group 1

Code	Background	Year of study	Role	Facilitator	Observer
N001	Nursing student	3	Nurse	Lead Researcher (JB, pharmacist)	CM (psychologist)
P001	Pharmacy student	4	Pharmacist		
D002	Medical Student	3	Doctor		

Event 4- Student Group 2

Code	Background	Year of study	Role	Facilitator	Observer
N002	Nursing student	3	Nurse		

P002	Pharmacy student	4	Pharmacist	Lead Researcher (JB, pharmacist)	CM (psychologist)
P003	Pharmacy student	4	Pharmacist		
D001	Medical Student	3	Doctor		
D003	Medical Student	3	Doctor		

Figure 2.7 Summary of volunteers, facilitators and observers in phase 1 of the study

Phase two originally intended to focus on how to upscale the intervention by employing fully mobile technology and delivering the simulation to students' own devices. The initial thematic analysis from phase one revealed some behavioural traits and educational ideas which warranted further explanation in a small scale intervention. In order investigate these behavioural traits in more detail and mindful of Olson and Bialocerkowski's assertion that IPE required more qualitative studies in interprofessional socialisation (90) the focus of study changed. In addition to this the design time necessary to create a fully mobile version of the VP fell outside the time limits of this PhD. For phase two, further refinements were made to the programme and student volunteers (n=27) were recruited from the schools of medicine, nursing and pharmacy. In order to explore and test the initial findings three further simulations were conducted: one containing only pharmacy students (with pharmacy students allocated the role of doctor/nurse/pharmacist in individual groups); a second contained pharmacy and nursing students; a third contained all three professions, in this case students were asked to role play another professional group (nurses played doctors, medical students pharmacists and pharmacy students nurses). The simulations were conducted in standard teaching rooms with connectivity to wifi. Students were allocated in each event to a sub-group of 3 or 4, each sub-group was provided with an iPad. The lead researcher acted as both a facilitator and as an observer in phase 2 events. Based on student feedback from phase 1, a less formal briefing was given to students in phase 2. This consisted of students being asked to introduce themselves to each other and then being briefed on how to use the technology. The written note (Appendix 5) was scrapped in favour of the phrase "A 65 year old gentleman has been admitted to hospital with breathing difficulties. You are the interprofessional team tasked with his care for the next 72 hours." Behaviour in phase two simulations was observed by the lead researcher taking guidance from the independent observer in phase one (see Figure 2.8 for detail). Again following the simulation focus groups were conducted with participants which were audio recorded and transcribed verbatim. The data from phase two was then analysed in the same method as phase one. A new theme was defined in phase two data; this warranted further exploration of phase one data to look for the concept in that data set. Once the data from phase one was re-analysed it was deemed that the data had reached saturation point and no further interventions were required.

Event 5 – Pharmacy only group (ten students split into three sub-groups)

Code	Background	Year of study	Group	Role	Facilitator	Observer
P010	Pharmacy student	4	3	Pharmacist	Lead Researcher (JB, pharmacist)	Lead Researcher (JB, pharmacist)
P011	Pharmacy student	4	3	Nurse		
P012	Pharmacy student	4	3	Doctor		
P013	Pharmacy student	4	4	Doctor		
P014	Pharmacy student	4	4	Pharmacist		
P015	Pharmacy student	4	4	Nurse		
P016	Pharmacy student	4	4	Pharmacist		
P017	Pharmacy student	4	5	Nurse		
P018	Pharmacy student	4	5	Doctor		
P019	Pharmacy student	4	5	Pharmacist		

Event 6 – Pharmacy and Nursing Students (8 pharmacy students, 4 nursing student split into four sub-groups)

Code	Background	Year of study	Group	Role	Facilitator	Observer
N003	Nursing student	3	6	Nurse	Lead Researcher (JB, pharmacist)	Lead Researcher (JB, pharmacist)
P020	Pharmacy student	4	6	Pharmacist		
P021	Pharmacy student	4	6	Pharmacist		
N004	Nursing student	3	7	Nurse		
P022	Pharmacy student	4	7	Pharmacist		
P023	Pharmacy student	4	7	Pharmacist		
N005	Nursing student	3	8	Nurse		
P024	Pharmacy student	4	8	Pharmacist		

P025	Pharmacy student	4	8	Pharmacist		
N005	Nursing student	3	9	Nurse		
P026	Pharmacy student	4	9	Pharmacist		
P027	Pharmacy student	4	9	Pharmacist		

Event 7 – Interprofessional Student Group

Code	**Background**	**Year of study**	**Group**	**Role**	**Facilitator**	**Observer**
N010	Nursing student	3	10	Doctor	Lead Researcher (JB, pharmacist)	Lead Researcher (JB, pharmacist)
P030	Pharmacy student	4	10	Nurse		
D010	Medical student	3	10	Pharmacist		

Figure 2.8 Summary of volunteers, roles, groups and facilitators in phase 2 of the study

2.4.4 Data Analysis

As previously stated the focus groups, semi structured interview and observational data were included in a thematic analysis.

Thematic analysis offers an accessible and theoretically flexible approach to analysing qualitative data and is compatible with the constructivist pedagogy underpinning this research. The thematic analysis presented here used an inductive approach described by Patton (1990) as cited in Braun and Clarke (204) where initial codes were derived from the complete data set without any prior coding framework being developed. These codes were then grouped into initial themes at a latent level, trying to identify not only what was said but what were the underlying behaviours and ideologies behind these statements. These initial themes were then revised based on further review of both the themes themselves and the entire data set. These final themes were then refined and defined with appropriate sub-themes being derived from the data. This process was completed by the researcher reading and re-reading paper copies of transcripts, identifying codes, and then highlighting areas of the transcripts which corresponded to codes with the use of coloured pens and highlighters (Appendix 7). This technique allowed the lead researcher to familiarise himself with the dataset, and also allowed for examination of what was not said as much as what was said.

It is acknowledged that my experience as a pharmacist may have influenced the interpretation of the communication, transactions and events during the simulation. As lead researcher I may have brought biases from my own past experience as both a hospital pharmacist, community pharmacist and as a lecturer. As a lecturer in clinical pharmacy and therapeutics it is also acknowledged that there was a power dynamic between myself and pharmacy students. This would be somewhat less pronounced with other professional student groups, however as faculty lead for stage 2 IPE I had certainly been in a position of power relative to the students in the past. This may have influenced student thoughts and responses in the focus group setting. Despite this acknowledgement of the reflexive relationship between myself and the participants (205), I felt it advantageous to conduct the facilitation rather than delegate to other tutors as my previous experience would allow me to quickly spot power dynamics in the simulation itself. Again with respect to analysis hand written notes were preferred to a computer programme such as Nvivo® as my experience may have highlighted significant interactions more succinctly.

Forty-six separate codes were initially derived from the data, these included emotions, feelings, opinions, behaviours and thoughts expressed by the participants. Initial analysis of these codes allowed them to be grouped into seven overarching themes: “soft skills”, “collaboration”, “technology”, “education”, “reality”, “future use” and “miscellaneous” (Appendix 8).

The initial themes were then reviewed in accordance with Braun and Clarke’s recommendations both at the level of the code and theme, and in light of the entire data set. This resulted in text which had previously discounted being coded and some text being recoded in light of the themes. A revised thematic map was developed containing four major themes “technology”, “education”, “collaboration”, and “emotions” and one minor theme “reality”. The previous theme “future use” was redefined as a sub-theme of education; “soft skills” was renamed as “emotions” with sub-themes of desirable and less desirable. On further reflection the minor theme “reality” was split into the sub-themes of “realism” which overlapped with technology and “real world comparisons” which is inherently intertwined with experiential learning, thus this sub-section of reality was subsumed into education. Further analysis of the data at the discussion stage led to the theme ‘emotions’ being renamed as ‘intrinsic behaviours’ as this more accurately reflected the diversity of responses coded under this theme. The final themes and sub-themes can be seen in Appendix 10.

CHAPTER 3 - PHASE 1 RESULTS - THEMATIC ANALYSIS OF OBSERVATIONAL, FOCUS GROUP AND INTERVIEW DATA

3.1 Introduction

The central tenet of this thesis is to ascertain if this technology is useful and effective for the delivery of interprofessional education to healthcare students. Therefore technology and education were considered to be the foundational themes relating to the project, and will be discussed first. The themes of collaboration and intrinsic behaviours are presented later because they relate to more abstract behavioural issues which are facilitated by the technology and can help to define the characteristics needed for an effective interprofessional education session, and less desirable characteristics which may undermine any intervention.

3.2 Theme 1 – Technology

Participant thoughts were sought regarding an innovative educational solution mediated by smart phone/tablet technology. Naturally there was much discussion regarding the relative merits of technology, future suggestions for improvements and limitations of the platform itself.

3.2.1 Enjoyment and Satisfaction

All participants expressed positive opinions about the platform and educational intervention. When the student groups were asked how the intervention made them feel, the initial response was "I enjoyed it". Students tended to express happiness with the immersiveness of the environment and the ability of the app to update in real time in response to student input. Both student groups compared the simulation to paper-based case studies and cited that this was both a useful way of learning and an improvement on more traditional teaching modalities.

"It's useful, definitely. It's a bit sleeker than having all paperwork and hassle. You just click a tab and it's nicely displayed." [D002]

"It's a lot more realistic than a case study as well. So when you're just given a piece of paper which says, 'This is what's wrong with someone. What would you do?' or you're going to give them that, you're a lot more invested in it. You have to think a lot more. You can't just tiptoe and google it." [P002]

Lecturers also expressed similar opinions with a physiotherapy lecturer stating:

"it's great fun…it will engage students…" [PY02].

As may have been expected the lecturers often expressed their opinions with students in mind.

NL01	They [students] do like it [simulation]
PL01	Really like it
NL01	I mean our students don't have as much as yours, but they like the simulation. Our simulation dummies that they have, because it makes them think.

Figure 3.1 Lecturers discussing student opinions of technology

3.2.2 Benefits of technology

Leading on from enjoyment, participants commented on a wide range of perceived positive benefits of the app. The technology certainly facilitated good engagement from the students with comments such as:

"If Keele does go live with that virtual sim, I think that would be more appealing for people who want to come doing their training because obviously, with all the cutbacks, a lot of universities are literally fighting for students and so this would be one appeal to it" [N001]

As well as articulating the fact that the technology would attract other students, other uses were proposed for the technology such as within postgraduate training courses, and as a revision tool:

"Yeah, postgrad training courses; maybe to stick in something like that [the app] just to test you." [D002]

Some lecturers also appreciated the technology citing slightly different benefits such as the technology's similarity to new developments in the workplace:

"… I think any type of a sort of interactive interface is good for students because I suspect the more places that you go to sort of, certainly in the sort of developed world if you go into hospitals, there's much more of these type of interfaces that you would work with.." [PY03]

3.2.3 Fear of Technology

Small generational differences were observed in the responses of lecturers and students, all students sampled were under the age of 30, whereas all lecturers were over the age of 30 and thus could be defined as millennials and non-millennials (206). Lecturers were the only group who explicitly voiced fears over technology whereas the students almost implicitly embraced the technology and found coping strategies which circumvented bugs and malfunctions which occurred during the simulation. Most lecturers agreed that the interface was easy to use and would be a useful teaching tool.

"Think I always have pre concerns about technology because I have a fear of it. [Oh I do too], But actually I was surprised at how easy it was to use." [NL01]

3.2.4 Real Time

The way in which the patient updated in real time provided a novel challenge to both students and lecturers. Lecturers commented on how the real time aspect of the simulation was an important learning tool for students and also mirrored the reality of healthcare work in practice.

"I thought it was a very good way to learn. To actually have to think on your feet, and respond." [NL01]

"That sort of learning progression, you know, I think any type of interface where they can see and manage almost in real time patient deterioration, patient [yeah] progression, patient changes or anything sort of like that I think is an important, that's an important learning tool." [PY03]

"They {students} all said it makes it more realistic, they can relate it better to practice than just a textbook, with a case written on a piece of paper, because you can see things happening." [NL01]

"it was interesting to see the response of the anaphylaxis, and highlight just how quickly that can happen." [NL01]

Students enjoyed the challenge of dealing with an acutely ill patient in real time, some felt pressurised for time whereas others were very positive when it came to observing changes in patient condition based on their treatment choices.

"I quite enjoyed the real time aspect of everything. Yeah, physically seeing the effect of the change that we made." [P003 and P002]

"Yeah it was quite a lot quicker as well, so it really makes you think what you are doing" [P001]

"yeah it is very constant, you're glued to it" [D002]

The real time nature of the app also helped some students to recognise their own limitations as can be seen from the following statement:

"What's happening and the quick response I would need if something like that does happen because I just of kind of went, 'I don't really know what to do here'." [P001]

3.2.5 Care/Engagement with VP

A number of comments related to how students cared for and engaged with the virtual patient. Positive comments surrounded the increased realism when compared to paper-based cases, and the fact that the avatar provided a focus for the students. Students believed this helped them to engage with the case more deeply than they would do with a paper-based case.

"It's more visual. We have a lot of paper-based cases and there's a lot of saying that this has happened; whereas, this is more visual." [N002]

Yeah, and you're a lot more invested in it. [P002]

Some dissatisfaction was expressed with regard to the interactivity of the avatar, with students expressing an opinion that they would like more interaction with respect to tests, interventions and responsiveness to questioning.

"Yeah, I think the only thing we noticed was his [the avatar's] lips were going blue, so we definitely gave him oxygen. It gave me someone to care about. Which was quite good. We just couldn't use him very much". [D003]

Others expressed an opinion that the avatar helped to suspend reality, and actually could help to build interpersonal skills:

"I felt like I was actually there." [PL01]

"You're more likely to build your interpersonal relationship skills with it as well, even though it's a computer but with a piece of paper, you don't need to do much with it." [N001]

Lecturers also acknowledged that the virtual patient provided a focus for the simulation, and as may be expected they also went beyond the actual technology into the philosophy behind virtual patients and how students interact with them:

"do students take them as seriously as they would a real-time patient" [PY03]

Following on from this the lecturer recounted an experience his students had had in the last year with SimMan®, another form of simulated learning.

"it was definitely raised by some of the students to say perhaps if it had been done under exam conditions, we might have had much more, it would have been much more sort of studious…You know, there was sort of a casualness around some of the students" [PY03]

Also of note may be the fact that both groups of lecturers decided to attempt to 'kill' the virtual patient, whereas students focused on saving the patient. This could be attributed to lecturers being more interested in the limitations and interactivity of the technology, rather than the educational intervention itself.

"'cause I think I tried to kill him, didn't I? [Yes, yes.] It's like let's see if I can." [PY03]

"I think you mentioned it just before DL01 decided to kill the patient." [Researcher]

3.2.6 Authenticity of Communication

Students all agreed the app would facilitate good communication between themselves in the current format where students all interacted with the virtual patient in a single room. Their thoughts were then turned to a future scenario where the app would be delivered to their mobile phones, enabling students to be in different locations whilst working together. Some students embraced this concept whereas others had reservations about how one would communicate in that way, and the authenticity of any communication facilitated by a mobile phone.

Yeah {I like the concept}, but I think the initial meeting is still important. [P003]

"Yeah, at least one and actually meeting each other in person" [P002].

These quotes reinforced the idea that students like to meet each other in person, others then explored the idea further questioning the style and authenticity of communication.

N002 *"Say some results came through and we say, 'Oh, we have to do that', would there be a separate section like a messenger and we can say, 'Shall we do this?' 'What do you think?'"*

Res *"yes, there would be a whatsapp style messaging service"*

D003 *"That might just take away from the actual interaction because... how like society is moving towards everyone communicating that way and people are losing the skills of actually talking to each other and that would take away from that."*

P003 *"I love the physical talking." {general agreement}*

Figure 3.2 Students questioning the validity of communication via mobile devices

3.2.7 Realism/Positioning

A strong idea which emerged mainly from nurses and physiotherapists related to the realism of the avatar, particularly surrounding its' position in a bed. The programme was designed to mimic a patient lying in bed with one pillow. For a patient with an exacerbation of COPD there are a number of physical manipulations regarding positioning which would make the patient more comfortable e.g. propping up a patient with 2/3 pillows, sitting them on the edge of the bed. These were not accounted for in the programme design and could not be achieved by participants.

"And I think, it's visually, in real life we'd be looking at how the patient looks how they're sitting or lying, just everything about them. Whereas on the screen they were lying straight in a bed." [NL01]

"There are some things like position because if you laid him flat, supine, you'd quickly run into a whole heap of trouble; so appropriate positioning in bed but you can't leave somebody sat up in bed and not move them" [PY02]

Nurses also commented on how they would normally use their powers of observation in practice to gauge how ill a patient was, again this was cited as a limitation for this particular technology.

"I think if you could see what the patient is doing or breathing, you can tell a lot from how the patient is positioned in bed, and what they are doing." [N002]

"The only difference, as we've previously mentioned, is you can't touch the patient… that's the only one factor that I would say would be your limitation" [N001]

3.2.8 Technological Thoughts

Students and lecturers both expressed positive thoughts and feelings towards technology, in some cases these involved suggested improvements whereas in others they expressed general opinions about the use of technology in education.

"I mean I the sort of development of these apps is really important. I mean I, from a user interface point of view the easiest or the least complicated, and the easier that it is to sort of manage {the better}" [PY03]

"It's useful, definitely. It's a bit sleeker than having all paperwork and hassle. You just click a tab and it's nicely displayed." [D002]

"I'm pro-technology. As soon as you mention paperwork, everyone just switches off straightaway but if you say it's on your phone, or iPad, or laptop, or something like, you think, 'Okay'". [N001]

3.2.9 Technological Improvements

By far the most frequently discussed topic with all groups involved suggested improvements to the technology. Despite most participants describing themselves as pro-technology a majority also focused how on the simulated activity could be improved upon, rather than commenting upon what it already did. These issues have been split into generic areas which are referred to in Table 3.1 below:

Suggested Improvement	**Number of times mentioned by participants**
Further questions of patient	9
Augmented Reality difficulties	5
Inactive areas	4
Positioning of patient	3
More cases/patients	3
Interface improvements	2
More physical examinations	2
Making an 'urgent' blood request	1
Lack of touch of patient	1

Facial expressions	1
Referral button	1

Table 3.1 Suggested improvements from the first phase of app testing

The most commonly cited improvement was the ability to ask further questions of the virtual patient. The scenario was deliberately designed with a multiple choice question scenario with nine limited questions which could be asked. Further questions were suggested surrounding medicine use, colour/consistency of sputum and further detail with regard to presenting complaint.

"{I'd like to ask about} Recent changes in his meds because it said he'd seen the doctor three days ago, so I'd like to talk about those three days" [P001]

"So definitely around sputum colour, consistency because that will differentiate between pneumonia and an acute exacerbation because the WCC is raised anyway" [PY02]

The programme was designed on the Unity platform with an augmented reality base, this allows the user to point a mobile device at a pre-defined picture which is then represented in 3D on the screen. This aspect of technology was not always favourably commented upon by participants.

"Disappeared to at the moment. Doesn't seem to be there." [PY03]

"{Do you think it's easy to use?} Yeah, apart from when we were changing the angle. He [avatar] actually ended up lying across the floor at one point {laughter}." [N001]

As could be expected with any technology at the beta-testing stage there were some technical glitches which resulted in inactive areas of the app. These included a lack of response to questioning, some blood results which should have had dynamic values which were fixed, and certain physical examinations which were inactive. Students seemed to cope well with this and used compensatory mechanisms to account for the lack of information.

"It gave me someone to care about. Which was quite good. We just couldn't use him very much." [D003]

"And I think there was also, am I right, there were, I think there were some inactive areas…" [PY03]

Positioning of the patient has been mentioned previously as a way of improving the interactivity and realism of the programme. Participants also thought that more cases would improve the realism, educational efficacy and engagement with the app.

The interface was widely appreciated as easy to use, although after conducting a 'physical examination' such as auscultation of the chest the app tended to revert to the 'home' screen rather than one stage up at the 'chest examination' screen. One participant cited this as an interface issue and suggested a few routes of improvement:

"There were, I think there were a few interface issues that we had sort of had on the day and that was, I think it was…perhaps the user interface where you sort of, you went into something and then you had to come out of something to go into somewhere [yes] so there wasn't a sort

of free flow of [mm-hmm] interface, which I guess might have been easier or might be easier to use" [PY03]

"I like the idea of an interface where if you're going to, if you have to switch backwards and forwards and for it, probably a new iteration actually finding out from the new software coming from Apple where they've got a permanent sort of tag box along where you can flick in and out, making it much more easier, 'cause I think when you go into some of these you sort of go, you probably go back and out rather than [yes] being able to just flick between them. Or being able to, you know, whether you can swipe left, swipe right so you sort of maximise that interface might be more, probably more intuitive to use." [PY03]

Other suggested improvements tended to surround patient management e.g. by being able to request urgent bloods, conduct further physical examinations, and refer to another practitioner. One further comment from a nurse concentrated on the avatar being able to express more emotions.

"As you said, this is just early stage of the development. Obviously, over time, as you go on and add more conditions, you'll adapt with it, so when you do the tests and stuff like that and when you do the examinations, it's a bit more responsive and maybe facial expressions or something like that." [N001]

In summary participants reacted positively to the technological concept of the app, and found it easy to use, some reservations and improvements were expressed particularly with regard to the communicative aspects of the simulation as a whole.

3.3 Theme 2 – Education

In general the intervention appears to have been a well received and successful with students demonstrating a deep engagement with the avatar, and responding to the simulation in a professional way, both students and lecturers commented on the multi-faceted educational themes and learning objectives which it could be used to achieve.

3.3.1 Technology and its' Relationship to Education

Participants were positive and emphasised the benefits of technology, with respect to education. Many benefits were considered including representing reality, using the app as an assessment tool for undergraduate and postgraduate study, using the app for revision purposes, and for increasing the desirability of the course to students.

"I know if I had that [the app] since Day One, I would have used it a lot." [N001]

Another desirable aspect of the simulation was the ability to see the improvement of the virtual patient in real time. This was cited as being preferable to both paper based case studies and experiential learning by students and staff alike.

"I like that we can see the results of what we do as well. It's much better." [P001]

Alongside the enjoyment of seeing improvements to the virtual patient in real time, the app also encouraged students to reflect on how efficiently they used their time. The scenario itself was deemed to be a little unrealistic as three people were looking after one patient for seventy-two hours. This seemed to make the students behave in an inefficient manner, leading to hyperobservation of his vital signs (Figure 3.3).

Researcher	*I think it's one of those things really that I noticed is in reality, would you spend as much time with that patient as you were doing?*
ALL:	*No (x 3).*
D002	*Yeah, I think it's different because you're just stood over the one patient.*

Figure 3.3 Demonstration of inefficient use of time mediated by the app

Solutions were proposed to this problem including limiting the time the students were allowed to spend with the patient, or adding more cases, thus creating a virtual ward. Time management was cited as a failing by some students with some good reflections on how they would cope in a similar situation in future:

"Well, no. We were just too hasty [P001]

"*… and we realised we didn't manage our time very well. If we were to redo that exact scenario now, we'd probably just find it really easy because you just get used to the system."* [D002]

Some lecturers commented that it would be useful to manipulate time in reverse as well as speeding it up. This would then allow lecturers to reinforce the critical decisions to make in a given situation to students. This envisaged using the programme in a more didactic manner than was originally intended.

Despite the fact the simulation was designed as a sub-acute scenario, observational data stated that the app helped the groups to work together in a positive manner, especially when it was an acute critical situation (e.g. when the patient is close to death). Future scenarios suggested by participants included further low intensity settings such as primary care.

3.3.2 Educational Uses

Comparison to Experiential Learning

Participants were extremely positive with regard to the simulation stating that it helped them put skills they have learned in the classroom into practise. Lecturers were confident that it would help to prepare students for the workplace they were entering. This was despite reservations with respect to the realism of the scenario, relatives speaking up for patients and the fact that the patient was totally compliant, which would happen in reality.

"I think in treating patients like that coming into A&E, you have a lot more going on around you as well. And there's usually a relative sitting there chirping in, so you're trying to listen to the patient and you've got a relative banging on in your right ear as well." [NL01]

Students and lecturers proposed a number of specific instances where they thought the simulation would be beneficial. This included prior to a first placement experience for nursing students, and prior to pharmacy placements to allow students to have a better therapeutic and pharmacological knowledge of therapies.

"even if we do our placements on this ward and if you then went and used that [the app] either before you went; just say you had a patient with cardiovascular problem, then go up on the ward and see him, in real life, I think it would be really good." [P001]

Students stated that experiential interprofessional learning opportunities were limited and often difficult to achieve. Mulitdisciplinary team meetings are often cancelled in practice, and thus the technology would allow this to be negated if necessary. Thought was also given to the virtual patient relying on the students to look after it. Students also acknowledged that they had to rely on each other's skill sets in order to treat the patient effectively.

Students were very positive about the fact that *they* were actually treating the patient rather than qualified healthcare professionals.

"I thought in contrast to what we see when we're on placement, I don't necessarily see someone in that acute setting and so it was good to actually practice carrying out a management on someone that's acutely unwell, rather than someone that's been in hospital for five days. Where you get to chat about what happened five days ago" [D003]

This clearly demonstrates the potential power of this intervention to replicate realistic medical conditions but allow a student to take charge of the situation. This train of thought was augmented by lecturers' thoughts on the benefits of this simulation, where they stated that the scenario allowed students, to play, try out solutions and respond to unexpected events in a safe environment. It was also suspected that this would improve students' confidence in the real world. As a counterpoint to the benefits of the simulation, lecturers acknowledged the reality and limitations of experiential learning in healthcare, this reinforced the opinion expressed by D003 previously.

[Referring to an acute anaphylactic reaction mediated by the app] *"Because that is just so related to clinical practice where we can talk about it in a classroom but, unless you actually see that and respond in a safe environment, you're not going to learn. Because in a pure clinical environment the students would probably be pushed to one side".* [NL01]

The lecturers then went on to articulate further drawbacks of experiential learning in the acute environment of the hospital:

"Suddenly it's manic, and very often the students will get left behind. [Yep.] Because they're not a priority. Whereas in here, you can see what happens in an anaphylaxis like what we saw, and how quickly, and what you could be doing, and I think that's just invaluable really, for their learning. [NL01]

"That's a good point actually because; you're more patient focussed than student focussed when you're doing something like that." [PL01]

In short this application allows a greater degree of freedom, realism, and control of a sub-acute hospital scenario than the widely established teaching modalities of experiential learning and problem-based learning.

Comparison to non-experiential learning

When comparing the simulation to non-experiential or classroom based learning participants concentrated their thoughts on six main areas summarised in Table 3.2 below:

Area of benefit	Number of times mentioned by participants
Technology better due to visual nature of app	8
Have to think more due to the interactive nature of app	5
Simulation is time pressured in terms of the patient	3
Simulation is sleeker, involves less paperwork	3
Instantaneous feedback	2
Improves decision making skills	1

Table 3.2 Summary of responses regarding the benefit of the app over 'case study' format

The visual element of the interface and avatar was thought to improve students' investment and "buy in" to the scenario. Particular elements included the fact that the virtual patient had blue fingers indicating peripheral cyanosis; which helped students to make a decision regarding oxygen therapy earlier than they would have done in a paper based scenario. As students felt they had to think more carefully, this shows a deep engagement with the learning process facilitating higher levels of achievement in Blooms taxonomy.

"you're a lot more invested in it. You have to think a lot more. You can't just tiptoe and google it." [P001]

Students also stated the interactive nature of the app increases the likelihood of students interacting in a class scenario. Lecturers supported this with thoughts such as *"simulation makes them think".* The pressure on students thinking time was cited unanimously as a positive aspect of the simulation, with students acknowledging that this helped them to collaborate more, think and act more clearly, and to make decisions with conviction. Less paperwork was welcomed in terms of an environmental concern but also in terms of improving engagement with the educational intervention:

"When it's on a piece of paper, you think, 'No change really' [laughter] but half an hour of this, it's like, 'Actually, ten minutes ago, this has happened, that's happened and that's happened'. So if they go on here, they're [other students] more likely to be interactive" [N001]

Instantaneous feedback provided by the app was also cited as an improvement on the case study methodology of teaching. Students cited that often they may postulate answers in a group setting but the facilitator may not be able to confirm or deny those suggestions due to time constraints or logistics.

Students and lecturers cited that the app could become a useful revision tool. Ideally two interfaces or methods could be used to deliver the scenario with the 'home' interface running quickly so the students could revise the subject matter in a timely fashion. "Real time" scenarios could then be used to deliver IPE interventions. When asked regarding the frequency and quantity required in order for the app to be useful, students responded that one case per major disease state would be desirable. There was agreement amongst the professions with respect to the app's use as a revision tool, with medical students stating that *'this would be useful on postgraduate training courses as well'* a student nurse also said:

"I know if I had that [the app] since Day One, I would have used it a lot." [N001].

One other concept which marked conversations regarding the educational benefit of the app was the level of difficulty of the simulation itself. The app was originally alpha-tested on a multi-professional group of lecturers who believed the students would need a little help or background information before using the app.

"If I use this in educational setting, I'd tell them what disease process they were going to be encountering and that would give them chance to read up about it. To get the most out of the scenario." [NL01]

In response to this, a briefing document stating the patient had a previous history of COPD was given to the students before the beta test of the app. When debriefing students, a polarised view to the lecturers was given, students thought the scenario was a little too easy and did not use all the examination features of the app because of this.

"we went into that knowing the diagnosis already. If you had it set up so that you didn't know that... because then the things like what we were doing with the respiratory exam and whatnot, that would become more useful. We clicked the auscultation button and it didn't really tell us anything new. We knew that he had an acute exacerbation of COPD. So if you just had a patient there, it would be a bit more real life, wouldn't it? And then you had to go and click it and do the examination" [D001]

"I think if we were diagnosing from the start, then it would have been more useful using the patient; whereas, the only thing I think we got from it was the questions that we asked at the start to know his allergies and his medical history." [D003]

This divergence of opinion points to an underestimation of student ability by the faculty, something which must certainly be addressed.

3.3.3 Educational Philosophy

Deep thinking and learning

Acquisition of knowledge and skills and behavioural change are considered by Barr to be higher level learning outcomes for IPE (60). These were demonstrated in a number of examples from phase 1. A clear example of teamwork involved the following exchange:

"I think he needs antibiotics because of what D002 said about signs of infection" [P001]

In the de-brief students tended to articulate their learning with respect to disease specific signs, citing the use of high-flow oxygen in carbon dioxide retainers and interpretation of arterial blood gases as particular learning needs. Deeper reflections included an acknowledgement of poor time management on behalf of the group, and a student pharmacist's honest reflection on their ability to deal with a crisis:

[In response to a question about educational learning gaps] *"the quick response I would need if something like that does happen because I just of kind of went, 'I don't really know what to do here'."* [P001]

Reflections of this nature allow students to form new paradigms of behaviour in similar situations in future, which will result in behavioural change. Learning objectives cited by lecturers included the real time management of patient deterioration in a multi-disciplinary team and understanding who they would call if they felt unable to deal with the situation. This was further supported by a pharmacy lecturer's assertion that professionals may not *know* the answer but do know here to look.

"That does illustrate a point that probably does happen in all our professions as well, is that you don't necessarily know all the answers, you don't have to hand but you know what questions to ask and you know where to get the information from." [PL01]

Another learning concept which arose from discussion was the ability of the simulation to force students into making clear decisions with regard to treatment, again this was cited as a positive effect of the intervention by both lecturers and students alike.

"When we were prescribing the drugs, it's almost like testing yourself in this situation. What can I give? You have to actually type it in and because it's so open, you have to go from scratch to filling it all in, don't you?" [D002]

"ok well I know most of the answers but it made me actually think and make a decision." [PL01]

A key aspect of this simulation would be the ability to leave students to work with and learn from each other with minimal facilitation from lecturers. There was a general consensus amongst students that this would be fair, with the proviso that there would be a member of faculty on call in case of technological difficulties.

"We'd go in a room with a BNF and crack on" [D002]

Staff thought this would be reasonable as long as there was a method of observing the interaction between students, and a way of observing their interventions with the virtual patient.

"Yeah I think that's a good idea, let them do the stuff, ask them to record their action, keep the notes of treatment, keep the notes of the patient response, I think would be better." [DL01]

3.3.4 Future Use

A lot of time in the focus groups and interviews was devoted to future use of the technology and advancement of the simulation. The general summary of thoughts is included in Table 3.3 below:

Area for future use	Number of times mentioned by participants
Further disease states	17
Students “on-call”	3
Pseudo cases (MSK chest pain, hyperventilation is asthma)	2
Dealing with consequences of a dispensing/prescribing error	2
Problem-based learning sessions	2
Observation charts	1
Inhaler technique	1
Shift work	1
District nursing visit	1

Table 3.3 Frequency of suggested future uses for the technology

There was wide variation in suggested future uses for the technology which generated some excitement amongst participants. Most areas considered were directly related to the current capabilities of the app, e.g. writing new cases, or using it in slightly different environments such as problem-based learning sessions. Making the application truly mobile led on to more innovative suggestions such as placing students on shift patterns or “on-call”, closely mimicking the workings of a hospital environment.

"It'd be very interesting if it was stuck on your mobile [Absolutely and it could just ping you every few days or something like that] That'd be really exciting, it really would wouldn't it? [NL01, with input from researcher]

Students thought this would be a good use of the technology, but did envisage some resistance amongst the wider student population, citing factors such as competing workloads and because night-time is not a usual time for undergraduate educational activities to take place.

"Obviously, if you're on placement or exams, just leave a little note so the computer knows who's doing it and then as you come onto a day, you could do a handover section. Obviously, people on nights are going to get bleeps, but they've got to get used to working nights at some point in their life. That way, you could work along those lines because that would be realistic. I know a lot of people would object to that but it's probably as close as they'll get before they go onto the ward." [N001]

Extending the database of cases to further disease states was the most common response to this line of questioning. However other situations were described which did not follow the traditional hospital admission. These included "pseudo admissions" where patients would present with the common symptoms of a condition e.g. MI but actually have a diagnosis of musculoskeletal chest pain; this would allow students to prescribe empirical therapy for the severe condition but then deprescribe later in the scenario. Other low acuity settings such as district nurse visits and dispensing errors were suggested as a way of engaging students. The suggestions for further cases included both acute and sub-acute scenarios ranging from myocardial infarction to diabetic ketoacidosis to management of thyroid disease and hypertension in the community. As one lecturer commented:

"I think, almost everything could be put in this type of simulation." [DL01]

One scheme of work proposed by the lecturers was to base a scenario around a psychiatric condition, with acute schizophrenia and bipolar mentioned as possibilities. It was acknowledged that there is a paucity of simulated activities relating to psychiatric illness; again the mobile iteration of app was thought to lend itself to the care of psychiatric patients, where students could treat a patient over the course of 12 weeks.

"I just think very often we concentrate on the physiological conditions and we forget about the psychological, and the psychiatric areas. And erm, even you know the adult nurses and the other medical students, they will see these coming through, so they need to be aware of well, who do you call? Because you can't deal with them yourself, you've got that specialist team who you need to bring in. But you've got to deal with that situation." [NL01]

Physiotherapy lecturers were invited to participate to see if the technology had potential beyond the professional groups it was originally designed for. Somewhat surprisingly the physiotherapy lecturers thought their students would be able to engage with the simulation as it stood if they used a little imagination. The strength of this feeling could be derived from the following statement:

"I think it would be a shame if physios weren't in this because I think this is the front door. This is where I've spent years of my life..." [PY01]

Areas where physiotherapy students could be expected to contribute included the interpretation of arterial blood gas results, and with supportive therapy to avoid patient deterioration.

"I think their reasoning at a Level 3 should be high enough for them to figure that out and to work with it, even if physio is not in there." [PY01]

"…we would expect them to know and understand; to recognise appropriate medical management." [PY02]

This assertion was somewhat contradicted by the lecturers difficulty in coping with different reference ranges to those they were used to seeing in practice. When challenged with the point that differing labs often have slight variations in reference ranges the group flatly refused to acknowledge this with the statement *"No, these reference ranges are incorrect."* Even the order in which the tests were reported was cited to be a difficulty:

"I think when we commented on these {arterial blood gas results} is that these were not, so we would normally see, we would normally have a pH first, then we would normally see [mm-hmm] pO2, PaCO2 bicarbonate and a base excess." [PY03]

Obviously further suggestions were made to enable physiotherapy students to actively participate in the scenario. These included interventions which would help to alleviate secretion-retention common in COPD patients, such as repositioning and percussion. A particular niche was cited with regard to muscle loss in bed bound patients.

"We see a loss of muscle mass in skeletal muscle, in quadriceps; to a lesser extent in the calf but we see that. That happens very, very early. I think that's something that the physiotherapy students need to be right on top of; that perhaps would be distinct from the medical and nursing role." [PY01]

Observing the data gathered from physiotherapists as a whole it was clear that they had good disease specific knowledge and were very happy to share it with others.

In summary the intervention was wholeheartedly supported and appreciated by the population studied. It certainly has huge potential to be used in a number of ways in future. It also appears to be a successful method for delivering interprofessional education.

3.4 Theme 3 – Collaboration

Effective collaborative working is a cornerstone of any fully functioning multi-disciplinary team (MDT), and consequently a desired outcome for any IPE intervention. WHO described the aim of a collaborative practice ready workforce as a desirable outcome for all mature healthcare systems (174).

3.4.1 Teamwork

Multiple serious untoward incidents in healthcare have been caused by a failure to work as a team. It is vital for any IPE intervention to address this and foster respect and teamwork amongst participants. It was clear that participants both actively worked together as a team, and also reflected on their abilities as a team, and the way in which the intervention brought them together.

Independent observation of the student groups recorded small changes in group dynamic as the simulation evolved. Generally each student was very polite and somewhat tentative to begin with, as the simulation progressed members of the team became more collaborative and consulted each other. No stereotypical power dynamics were observed however it was observed that patient care tended to suffer when nobody took charge.

"At this point nobody has really taken charge and they have all suggested different tests/observations/checks/questions which has not taken much effect so far." [Independent observer]

Participant reflections on the experience supported the view that the app actually mediated communication between team members, as opposed to mediating direct communication between participants and the device to the detriment of team communication.

"It makes people talk, and that's something you're actually doing and we can communicate and talk." [D003]

Again students reflected that they worked very well together as well as citing the importance of working with other professions:

"I do prefer it with different disciplines though, if it was the same [professional groups] it would lose something." [N002]

This view was echoed by lecturers who thought it was good to have the mix of professions and furthered that though by comparing the simulation to real practice:

I think because very little medicine is done on an individual basis, you're largely working in a team. So I think if you can have any interaction with a team, that's great!" [PY03]

"Everybody makes mistakes so actually you need your whole team with the knowledge, the skill, the insight…" [PY02]

Students reinforced these thoughts by commenting upon where they as individuals needed to turn for help in the situation, and acknowledging the gaps in their knowledge which could be ameliorated by others:

"I think it highlights the fact that you need to work as a team, which is good. And it might pick out gaps in your understanding…that's why I'd need such and such a body to come in and help. It makes you more aware." [D003]

This degree of teamwork allowed a shared decision process to take place in order to treat the virtual patient.

"I thought it was good that you could all decide on what was the best course of action" [D003]

This collective and collaborative approach underlines the potential for this app to be effective in the delivery of interprofessional education. Conversely to the students, some lecturers actively acknowledged that they may have behaved in a stereotypical way whilst interacting with the app. This may be due to past experience influencing their behaviour whilst dealing with a situation:

"I think we have been quite stereotypical haven't we? …we honed straight in on the respiratory and I don't think a nurse or medic would necessarily go straight to respiratory" [PY02]

3.4.2 Communication

Communication is clearly a critical component of good teamwork, the simulation facilitated discussion, learning and teaching and some disagreement amongst participants. Independent observation of the student group dynamics revealed changes in communication based on the condition of the virtual patient.

The first student group gave the virtual patient an increased concentration of oxygen, which resulted in the patient going into type II respiratory failure. This triggered an alarm to go off in the app which altered the entire group dynamic.

"Particularly after the alarm had sounded all members became less polite and tentative; and more confident and forthcoming with their suggestions." [Independent observer]

Professional disagreement

Whilst not actively acknowledging this in the focus groups, one of the most important aspects of collaborative practice is the ability to disagree and challenge one's colleagues. Independent observation revealed both student pharmacists and student nurses disagreeing with suggestions made by the medical students, demonstrating confidence in their abilities. The medical students were content to take this advice, suggesting they were happy to collaborate in a team.

P002 politely disagrees with D001 and D003 based on his pharmacy expertise and gives specific advice N002: *"Don't skip too far ahead, I want to keep checking his obs."* N002: *"But his obs may come down with that, what else can we give him?"*

Figure 3.4 Examples of professional disagreement recorded by the independent observer

This suggests that this simulation avoids reinforcing physician power as cited by Kuper and Whitehead (82).

3.4.3 Reliance on, and Benefit of, Each Other

One of the clearest ways in which students demonstrated good team working behaviour was by relying on each others' knowledge base and acknowledging their individual limitations.

The concept of the "experienced student" was introduced by students (all had completed at least three years of study by the time of the intervention). Students offered the opinion this was vital to good interprofessional teamwork, because they would be aware of their own and others strengths and weaknesses.

"I think it's only because like you said, we're well into our training now and we already know what everyone's limitation is to a certain degree. Obviously some will take the role in certain areas; some will take a step back and forth because they're relying on other people's experience and they can do it." [N001]

"Everyone kind of knows their role a little bit more and responds to that. They get what they have to do. Obviously if you're in a group you reflect on that." [P001]

These experienced students, tended to take a lead in tasks where their knowledge was more complete, or where they considered themselves to be competent. This could be misconstrued as stereotypical behaviour, however this behaviour tended to improve collaboration and consequently improve the care of the virtual patient. Accurate evidence for this behaviour was provided by the independent observer as seen in Figure 3.5 below:

P001 - Prescribes drugs.
N001 – Takes down obs.
D002 – Provides an explanation for the current obs levels and recommends keeping an eye on them.
P002 and P003 - consulting each other and the BNF.
P002 – Directed towards D001 and D003 *'So do you want me to find an alternative drug?'*
N002 – Reads and notes down obs levels.
D001 and D003 – Examine X-ray and consult reach other on assessing it, then explaining to the group what it shows.

Figure 3.5 Independent observation of students acting within their competency

This was summarised by the independent observer noting that there was a clear role of each profession in each group. The nurse consistently focused on observations, pharmacists on drugs and doctors on the physical examination and overall knowledge of the situation. Each member of the team was able to defer based on their professional knowledge, relying on each other especially when it was an acute critical simulation. Students in the second group fell in their 'roles' more quickly than the first group, possibly because the pharmacy and medical students had someone to confer with intraprofessionally.

In contrast to the separate yet complimentary roles referred to by the independent observer; physiotherapy lecturers referred to some overlap in the roles between themselves and nurses. This was tempered by the assertion that each profession would approach a problem in a differing manner:

"Again overlap with nursing because they too understand the need for mobilising patients and changing position. But not perhaps have the same emphasis and priority as physiotherapy students" [PY02]

Many examples of explicit reliance on each other were revealed by the research, demonstrated by the response of both student and lecturer participants. These normally took the form of direct questions regarding an aspect of care as can be seen in Figure 3.6 below.

D003 – [Directed at P002] *"How much paracetamol do we give?"* P002 and P003 – [Consult each other and give advice] N002 - *"But his obs may come down with that, what else can we give him?"* Uses her experience and knowledge to demonstrate that it is inappropriate, but still relies on pharmacists' further knowledge about alternatives.

Figure 3.6 Conversation between participants demonstrating explicit reliance on each others' knowledge.

Lecturers positively demonstrated this behaviour in their group as the nursing lecturer specifically asked the pharmacist about the dose of a medication. Students also reflected on their reliance on each other in the focus groups, showing solidarity to each other by identifying their own weaknesses:

"yeah, there were certainly parts I'd have no idea about, like X-rays or mechanical ventilation. If you showed me an X-ray I wouldn't know what to look for." [P003]

"sort of likewise on drugs as well, dosing and stuff." [D001]

This reliance manifested itself in a positive manner where students started to learn with, from and about each other, by directly asking each other the significance of findings which were being related to the group. This possibly could have detracted from patient care, but it improved the learning experience for students.

D003 –	Reads out abdominal exam.
P002 –	*'Cool. So what does that mean?'*
D003 and D001 –	Explain abdominal exam.
D003 –	*'We really need to do something now'*.

Figure 3.7 Conversation demonstrating explicit learning from and with each other

This inquisitiveness between different professional groups was cited as a benefit of the experience by students:

"Yeah I think it's good because we're obviously working with different professions and you think about what tests you need to do that other people would be interested in. You get an idea of what everyone is looking for as well as what you should look for." [D002]

This reliance on each other expressed itself fruitfully when it was articulated that the different professions share a collective responsibility for patient care:

"Everybody makes mistakes so actually you need your whole team with the knowledge, skill and insight" [PY02]

Students were asked if they thought the app would be suitable for use in a uniprofessional group e.g. for pharmacists only. The response to this was positive but they believed they would struggle if the simulation was presented in the same format as for an interprofessional group. This idea could be furthered if a professions lack of knowledge in certain areas could be ameliorated by further information being interpreted or presented in a different manner.

"If you were to do it as a group, say on the same course then you might realise 'I don't know that'. That's why I'd need such and such a body to come in and help. It makes you more aware." [D003]

"You could maybe run it where you had everyone from one course…could you give them the information that they would not have" [P002]

This demonstrates students' belief that they need the expertise of their colleagues whilst dealing with virtual patients.

3.4.4 Other examples of collaboration

Pharmacist as conduit of information and deference

Early in the first student group before the alarm sounded students were polite with each other but were not demonstrating ideal characteristics of good teamwork. It was observed that the pharmacist [P001] was acting as a conduit of information between the nurse and doctor. The student doctor and nurse were more actively involved in patient management at this stage of the scenario, but rather than speaking and consulting with each other they spoke to the pharmacist who was holding the iPad at the time. This could be viewed as students interacting with the technology rather than each other, or that the pharmacist as the less experienced member of the team was acting as a conduit of information between two competing methods of caring for the patient.

This was complimented somewhat by the pharmacist acting in a deferent manner to other members of the healthcare team. This was only evident from observational data and was not explicitly acknowledged by students in the focus groups, an example is given in Figure 3.8 below:

D003 – Directed to P002 *'Want to give him steroids?'* P002 – *'It's up to you'*. Makes doctor make the decision, but provides advice on which steroid to prescribe.

Figure 3.8 Example of pharmacy student deferring a decision to another professional

Another example involved the pharmacist taking a back seat in early conversations regarding diagnosis and treatment, this could perhaps be related to their relatively short exposure to experiential learning in their undergraduate course.

"Initially D002 was the dominant member of the group, P001 remained fairly quiet and controlled the iPad, following actions suggested by D002 and N001." [Independent Observer]

Who prescribes?

A further more philosophical point was raised amongst students and lecturers, the question of who prescribes treatment for a patient. When first qualified the only profession represented who would have the legal power to prescribe and write prescriptions would be the doctor. Despite this thought was given to who actually makes the choice to prescribe an agent, even though the doctor will take ultimate responsibility.

"the junior doctors really prescribe. They write the prescription" [Researcher]

"But there's a nurse or physio poking them in the ribs saying 'Have you thought about?' or a pharmacist comes down with their green pen and write all over the chart" [PY02]

"we wouldn't expect our graduate physios to have that sort of influence…" [PY02]

"..for oxygen? Yeah, I would." [PY01]

Physiotherapy lecturers expected their students to have an understanding of what constituted good prescribing, and be able to comment if poor prescribing occurred. Pharmacy lecturers also thought this was integral to their professional role. To further thought on this question the app was designed so that any professional group could actually prescribe medication and oxygen. When students were directly questioned regarding this feature, they expressed the opinion that it would be useful to leave it open to all professionals, as this would encourage collaboration.

3.5 Theme 4 – Intrinsic Behaviours

This theme relates to student responses which were either not envisaged in the preparation for the simulation, or innate responses to the technology and other team members which are tangentially related to collaboration and teamwork. These responses could also be termed as 'soft skills', facets of emotional intelligence essential for good healthcare but notoriously difficult to teach. These intrinsic behaviours can be split into four categories, positive behaviours, leadership, followership and negative behaviours. Initially they were termed solely as positive and negative; however this terminology was deemed unsuitable because negative behaviours such as deference and cautiousness could be considered to be useful dependent on the exact situation.

3.5.1 Positive Behaviours

Care/engagement with VP

Demonstrating care, beneficence or making patients your first concern are key priorities for each of the professions represented in the research. Observational data demonstrated that all participants showed empathy and engagement with the virtual patient; demonstrating compliance with professional standards. Participants believed the avatar increased engagement with the simulation, comments tended to praise the visual nature of the simulation.

"It's all about seeing him as well rather than on a piece of paper. You're seeing him. You're seeing his changes" [P001]

The last sentence in the quote above generates the possibility of the avatar being conflated with other interactive elements of the technology such as the vital signs monitor. A desire for more interactivity from the avatar itself was expressed, in combination with an acknowledgment of the usefulness of visual cues provided by the avatar:

"Yeah, I think the only thing we noticed was his [the avatar's] lips were going blue, so we definitely gave him oxygen. It gave me someone to care about. Which was quite good. We just couldn't use him very much". [D003]

Care of the virtual patient was demonstrated in a number of differing ways by participants, the scenario managed to 'suspend reality' a key characteristic of a good simulation with participants saying 'I felt like I was really there working with you'. Participants, especially students started to undertake almost constant monitoring of the patient showing an emotional attachment. When compared to a paper based case, it was commented upon that students could build up a personal relationship with the avatar which they wouldn't with a piece of paper.

"you're more likely to build an interpersonal relationship with it as well, even though it's a computer." [N001]

An almost addictive response to the virtual patient was elicited in a few participants, showing a deep engagement which probably would not be true to reality due to competing interests in a ward environment.

"We did keep going back to see – 'let's have a look at what he's doing now'" [PL01]

"You're glued to it." [D002]

Experimentation and confidence

As well as improving student awareness of patience and bravery, confidence was cited as another benefit of this approach to learning. When asked explicitly as to what they learned from the simulation some students acknowledged their lack of confidence in certain situations:

"...the quick response I would need if something like that does happen because I just kind of went – 'I don't know what to do here'" [P001]

As students would be able to repeat the scenario if their care was unsatisfactory, lecturers thought it could be a powerful experience allowing students to experiment with different techniques in a safe environment for patients. Experimentation was related to confidence, as more experience with challenging situations allows students to normalise the event and think more clearly if such an event occurs again.

"I think this allows them to experiment as well...and through that they will gain their confidence." [NL01]

"'Cause we teach them all day long about what to do in a cardiac arrest, when you're actually in a cardiac arrest you forget it all." [NL01]

3.5.2 Leadership

Use of time (time management)

Another key competence of a healthcare professional is effective time management and prioritisation of tasks. As the simulation was focussed on one patient, triaging skills were not examinable; however the importance of timely interventions was easily demonstrated to students by the deteriorating condition of the patient. When the virtual patient became acutely unwell, this increased participant's focus, with direct communication and action taken within the groups.

"it's the time and how quickly you need to respond. Like the anaphylaxis and how quickly that happened and despite us punching all those drugs in he still died." [NL01]

Students reflected on their use of time in the focus group. In less acute stages of the simulation students were observing the patient at regular intervals with little action taken.

One student commented that this was becoming a little tedious, and when questioned as to whether they would normally spend as much time with one patient, a unanimous no was given. Students tended to reflect on their time management post-simulation and suggested improvement for their future practise, demonstrating that the simulation allowed for reflection on mistakes a key aspect of experiential learning.

"…and we realised we didn't manage our time very well." [D002]

Bravery

Another character trait exposed by the simulation was bravery (or the lack of bravery) when prescribing treatment for the patient. This could also be linked to management of risk. Bravery in respect to the simulation was observed when participants continued with correct decisions in the face of conflicting data. Examples of scenarios where bravery was required included continued elevation of heart rate despite adequate oxygen therapy (where heart rate would slowly return to normal), and continuing elevation of temperature following administration of appropriate antibiotics (antibiotics would only start to affect patient six hours post administration).

Participants dealt with these situations with various mechanisms, and the continuing worsening of patient condition tended to elicit either cautious watchfulness or desperate measures.

The only actively brave response was elicited from a lecturer in nursing (the participant with the greatest clinical experience in the area), however this response was given in the focus group following the scenario and somewhat contradicted their behaviour in the simulation itself.

"For a patient like that you wouldn't get any response in the first couple of hours initially. But you'd be monitoring them every quarter of an hour. But you wouldn't just expect him to perk up suddenly because they're chronic patients." [NL01]

In the simulation this particular participant advocated giving the patient digoxin to lower their heart rate, an unnecessary intervention once adequate oxygen has been administered. Students demonstrated familiarity with the monitoring concepts proposed by the lecturer, with the comment:

"Once you've done something wait 15 minutes then check again." [D002]

This demonstrates a pragmatic approach to treatment and monitoring advocated in the National Early Warning Score (NEWS) system developed to spot patients at risk of sepsis. Most students were more cautious than lecturers, as one would expect from less experienced practitioners. This was both observed and explicitly acknowledged by students themselves:

"At first we were a bit cautious of how quickly he [virtual patient] could deteriorate." [D003]

The phenomenon of cautiousness seemed familiar to pharmacy lecturers who cited it as a barrier to effective learning and practice.

"*I don't know if it's the same in the medical and nursing professions. It's that sometimes the students are….shall I say frightened, frightened to make a mistake, frightened to make an error even in class."* [PL01]

This was expanded upon with examples and the opinion that the solution was unclear:

"It doesn't matter how much you try and instil that it's ok [to get the wrong answer]…it's certainly a big issue, improving their confidence" [PL01]

(Forced) decision making

The simulation asks students to prescribe drugs based on their diagnosis and assessment of presenting complaint. Above and beyond standard classroom and experiential learning scenarios students have an open interface where they prescribe drugs and oxygen in order to treat the patient. Participants cited that this forced them into making a decision or taking a particular course of action, thus increasing their confidence and bravery in future scenarios.

"When we were prescribing the drugs, it's almost like testing yourself in this situation. What can I give? You have to actually type it in, and because it's so open, you have to go from scratch filling it all in don't you?" [D002]

"So it's forcing you to pick a drug, rather than saying 'I'd give him a steroid'?" [Researcher]

"Yes." [ALL]

Lecturer participants reinforced this train of thought, citing that the simulation

"…*I knew most of the answers, but it actually made me think and make a decision."* [PL01]

Clear decision making is a critical skill for students to learn in order to practise effectively, the simulation appears to facilitate this by forcing students to make choices and react to their consequences.

3.5.3 Followership

These behaviours are less extroverted and sometimes submissive. They are not negative in the context of teamwork as leaders require followers, and contribute to the effective functioning of teams.

Seeking reassurance

One of the key aspects of the simulation is that it allows students total control over diagnosis, monitoring and treatment. This cannot be replicated in any other sort of environment as even on IPE wards cited by Pelling *et al* (79) there has to be some level of oversight by qualified clinicians. Students appreciated the challenge this provided them but also expressed some unease about the situation.

Res:	*...have you ever been in a situation...where you haven't had anyone to look to? How did that make you feel?*
D003:	*"I felt like I wanted to look to someone {laughter}"*
Res:	*"Is that fairly standard across you all?"*
ALL:	*"Yes."*

Figure 3.9 Student response to being left in charge of the patient

Students didn't only look for external reassurance, independent observation showed they also asked each other for affirmation for their decisions:

*"**I think** he needs antibiotics because of what D002 said about signs of infection."* [P001, emphasis added]

It would be of interest to investigate this further to see if it is a phenomenon particular to one profession. Lecturers approached the question of reassurance from the angle of independent learning, a desirable characteristic for any student at Batchelor's level study or above. It was opined that it would be better for students to undertake the simulation without direct observation in a room, because *"they would look to that person for approval".*

Refer to Senior

Leading on from looking for reassurance was the opinion that participants should be able to refer the patient onto a more senior practitioner. This was cited by both professionals and students alike, and replicates standard practice for all clinicians below the consultant level. Participants felt this was an essential skill all competent professionals should have.

"If you didn't know what to do, you'd find someone more senior who did." [D001]

"I'd get my consultant, I would call the senior people at that point" [NL01]

[in response to a discussion about non-invasive ventilation or intubation] *"That clinical decision making is of a higher order, I would expect a consultant to do that."* [PY02]

Participants felt this could be addressed by the addition of a "refer to consultant" button which could be pressed if they were struggling with the management of the patient.

Cautiousness

All students undertaking the scenario demonstrated a cautious attitude to the patient especially in the sub-acute parts of the simulation. This manifested itself in three separate ways: constant monitoring or hyper-observation of vital signs, inaction and overtreatment. This behaviour correlates with seeking reassurance and referral to a more senior practitioner and has been commented upon in more detail above.

Deference

Deference to people perceived as being more powerful, or having greater experience was independently observed in interactions between students. This was not explicitly commented upon in focus groups. Much IPE work has an underlying aim of avoiding potentiation of physician power, and thus the presence of deference could be perceived as unhelpful. Deference was observed on three separate occasions and in each case a pharmacy student was acting in this manner. One scenario involved a pharmacist passing a decision back to a doctor, but then providing support for the doctor to make that decision:D003 – Directed to P002 *'Want to give him steroids?'*

P002 – *'It's up to you'*. Makes doctor make the decision, but provides advice on which steroid to prescribe.

Figure 3.10 Example of pharmacy student deferring a decision to another professional

Another example showed the pharmacist reflecting on their own lack of expertise in the area and asking for further guidance:

P001 – To both D002 and N001, *'In that situation, what would you do?'* D002 and N001 consult each other about what they would do, ie physical interventions rather than drugs.

Figure 3.11 Example of pharmacist asking for support in their understanding of the situation

Further independent observation showed the pharmacist taking a subservient role in the initial treatment of the patient:

"Initially, D002 was the dominant member of the group. P001 remained fairly quiet and controlled the iPad following the actions suggested by D002 and N001. D002 and N001 both talk directly to P001/the iPad rather than talking to and consulting each other." [Independent observer]

Although deference could be seen as a weak behaviour which would be considered undesirable in an IPE intervention, it could also be seen as essential for good teamwork. Independent observation cited that patient care suffered until someone takes control of the situation, deference could facilitate the formation of professional relationships. It is also worth noting that deference did not seem to be universal or render the value of knowledge from the deferent individual ineffective. Even following the deferral of the decision the pharmacist acts in an advisory role to the doctor, this possibly reflects on the pharmacist's stereotypical view of their own role.

3.5.4 Negative Behaviours

These behaviours did not serve any useful purpose for the functioning of the team and could be detrimental to patient care and interprofessional relationships.

Lack of Patience

One behavioural trait exhibited by participants in the simulation was patience, or more accurately their lack of it. Observational data shows the simulation teaching students the value of patience and waiting for an intervention to work. For students, it is difficult to model how long an intervention would take to work in reality in an educational setting. For instance paper-based cases or problem based learning scenarios do not update in real time, resulting in students possibly perceiving that treatments work instantaneously, as long as they give a correct answer then their patient will get better. Reality is obviously more complex than this, experiential learning in placements would allow students to observe patient recovery, but they would not be making the decision to treat. Again they may be involved in care of an ill patient, but they would not be observing them in a constant manner. For instance, if a nurse set up an antibiotic drip for a patient, it is unlikely they would be observing a patient for an hour for reductions in temperature or normalisation of blood pressure, the app allowed students to do this and they availed themselves of this opportunity.

As a result of this hyper-observation students tended to express some impatient behaviour to the detriment of the patient. For example the patient is programmed to respond to antibiotic therapy only six hours after the initial dose (so the patient’s basal body temperature increases in this period), this elicited a feeling of unease amongst students.

Researcher:	*you put him on the right therapy and his temperature carried on going up. How did that make you feel?*
P002:	*Nervy.*

P003:	*You question whether it was the right therapy and that's why I was just constantly thinking that we weren't on the right antibiotics or there was an interaction somewhere that was going on.*
D003:	*Maybe we were doing it too by the book and maybe in practice, you'd do it... well, not by the book as much...*

Figure 3.12 An interaction demonstrating student feelings and thought process whilst waiting for a correct intervention to work

This impatience was not solely confined to students, lecturers also commented upon the fact that they tried almost anything to improve the patient's condition because they could see a deterioration happening before their eyes.

"But we were so desperate because we could see that ECG – 'get something in there!'" [NL01]

When questioned further on this matter participants focused on the fact they saw a real-time deterioration before their eyes. For instance temperature and SpO_2 are displayed to two decimal places thus the drop was exaggerated as participants could see the temperature increasing in a matter of minutes from 37.81 to 37.82 and so forth.

"I think because you are stood there waiting for a change, it feels like when you do something it skips forward a bit just to see the response. Like you say, you're stood there waiting and then you're thinking 'What can we do? What can we do?' straightaway and constantly trying to add more things into him where probably you could just leave him for a bit." [P001]

This effect seemed to increase both the stress and immersive nature of the simulation, whilst encouraging students to reflect on their patience post-simulation.

Confusion/ Panic/ Pressure

The simulation evoked feelings and behaviours which reflected confusion, panic and pressure amongst all participants. This demonstrates that the simulation suspends reality and enabled participants to form a relationship whereby they cared for the virtual patient. Confusion and panic were reported most frequently when the patient's condition was deteriorating, especially after an intervention had been applied.

"His sats went down again and that confused us all and got us in a bit of a panic." [D003]

"it was the rate at which they were dropping as well" [P002]

"You question whether it was the right therapy." [P003]

"Before you hit the peak of the curve, you were really worried." [Researcher observation]

Students were possibly struggling to cope with the concept of waiting for interventions to take effect. This could be related to impatience amongst millennials referred to by Prensky and Sinek, however the practice was also observed amongst lecturers who would not fit that descriptor.

"…oh actually I thought that was a good idea [administering digoxin], but you brought us back down to earth. [Facilitator told participants digoxin had no effect in simulation]. But when you're in that situation you're trying to think heart rate, something that reduces the heart rate! But we were so desperate because we could see that ECG!" [NL01]

A more appropriate explanation could be that people expect instant results from technology rather than having to wait for them. Participants also related stories from practice where they had similar feelings, citing first placements and acute events in hospitals as examples. Again the fact the simulation evokes these feelings can be seen as successful as it is replicating realistic conditions which are extremely hard to generate in the classroom.

Disappointment at failure

Both student groups 'failed' the scenario in terms that the patient died whilst they were looking after it. Disappointment at this outcome was expressed particularly by students who had treated the patient effectively for 48 hours.

"…and the fact we were supposed to do three days, and the fact we'd made it that far to sort of fall at the last hurdle." [P002]

"We thought we would send him home." [D003]

Disappointment is a useful emotion in that students wished to try the scenario again to correctly pick out their mistakes and improve their knowledge. Future use of this technology may allow students to become more accustomed to learning from failure.

Irritation/Boredom

Irritation and boredom were two of the most negative attitudes caused by the simulation. These were related to either having to wait for improvement or not having enough to do in the scenario. Participants proposed the use of more than one patient in a scenario to circumvent the latter problem. The former issue manifested itself in a number of ways such as explicit mentions of boredom (Figure 3.13).

P003: *"Could you maybe have more than one bed to manage? So you're not having to skip forward because you'd be bouncing around all the beds?"*

Res: *"It's something we could look into….I think someone mentioned the word tedious at one moment, and that's because patients take time to get better."*

Figure 3.13 Responses and thoughts regarding boredom facilitated by the app

Both groups of lecturers responded to the challenge of boredom by attempting to kill the patient by inducing an anaphylactic reaction. This was cited as a way of testing the technology to see what it was capable of.

In summary the emotional responses elicited by the simulation were varied and in some cases unexpected. The behaviours displayed cover many facets of good teamwork and communication and will facilitate a powerful and unique learning experience for healthcare students.

3.6 Key Findings

- The app was viewed as a novel and enjoyable educational intervention by all participants.
- The real-time nature of the simulation increases student engagement in comparison to traditional forms of learning such as case studies.
- Similar to simulations modelled by technology such as SimMan® students are allowed total control of decisions and see the consequences of those decisions.
- The flexibility of the technology allowed the simulation of a sub-acute scenario. Despite the sub-acute nature participants still experienced pressure to make decisions quickly and efficiently.
- The hyper-realistic nature of the scenario caused participants to hyper-observe the VP, to the detriment of patient care. Participants reflected on how this teaches the soft skill of time management
- The simulation encouraged participants to take a collective and collaborative approach to patient care and decision making. Participants actively relied on each others' expertise to solve clinical problems.
- Medical students were open to challenge from their professional colleagues
- Participants sub-consciously fell into stereotypical roles of their profession. These job roles were complimentary and allowed the team to function more effectively.
- Pharmacy students were found to be deferent and reluctant to take final responsibility for prescribing decisions despite their expertise in this area.
- The simulation allows participants to model leadership behaviours such as bravery.
- Participants experienced confusion, panic and pressure at critical points in the simulation. This demonstrates that participants were immersed in the simulation and forming an emotional attachment to the VP. The simulation thus allows students to

experience some of the emotional burden of caring for a real patient, in a patient-safe environment.

Chapter 4 - Phase 2 Thematic Analysis

4.1 Introduction

The initial findings from Phase 1 identified behaviours, particularly surrounding theme 4 – intrinsic behaviours which warranted further exploration in terms of reproducibility. The technology itself was updated in response to valid complaints received in Phase 1, these did not affect key characteristics of the software but involved the repair of dead links and the updating of biochemical parameters to produce a more dynamic picture of the patient state.

Three separate sessions were conducted with observational data recorded from the simulations by the lead researcher. These sessions consisted of a mix of undergraduate professional groups (one pharmacist only, one pharmacist and nurse, and one pharmacist, nurse and doctor). A total of 22 students participated in stage 2 of the study. In two of the sessions students were actively asked to "role-reverse" and to play the part of another professional group rather than their own. Role-reversal was used to see if discomfort and unfamiliarity with a situation had any bearing on individual and group behaviour. A focus group de-brief followed the simulation, which was audio recorded and then transcribed verbatim in the same manner as phase 1 of the study. An extension to ethical approval was granted to allow research to take place beyond the initial timeframe, and to vet further topics to be explored in Phase 2.

The four themes derived from Phase 1 of the study were used to form the basis for a second thematic analysis. Most of the data fell into one of the four original themes, however eight further codes (see Table 4.1) were used where the data did not clearly fit into a theme, or presented original data.

Code	Name
A	Stereotypical behaviour
B	Subversive behaviour
C	Real life experience
D	Stereotypical education/experience
E	Technology as an aid to withdrawing information
F	Engagement with IPE
G	Prior knowledge to play role of other profession
H	Lack of worth

Table 4.1 New codes derived from phase 2 data

These eight codes were then reviewed and either combined with the four previous overarching themes or due to the amount of data collated, placed in a new fifth theme of stereotyping. The table below summarises how the data was placed into themes.

Code	Name	Theme
A	Stereotypical behaviour	Theme 5 – Stereotyping
B	Subversive behaviour	Theme 4 – Intrinsic Behaviours
C	Real life experience	Theme 2 – Education or Theme 5 Stereotyping
D	Stereotypical education/experience	Theme 5 Stereotyping
E	Technology as an aid to withdrawing information	Theme 2 Education
F	Engagement with IPE	Theme 3 Collaboration or Theme 5 Stereotyping
G	Prior knowledge to play role of other profession	Theme 3 Collaboration
H	Lack of worth	Theme 4 – Intrinsic Behaviours

Table 4.2 Thematic placement of new codes

As stereotyping emerged as a strong theme from the Phase 2 interventions, Phase 1 data was analysed again to look for any overt stereotypical behaviour or education. There were echoes of stereotyping in phase 1, however the data set was small as the researcher was not actively seeking it in phase 1 analysis. This data is presented below (chapter 4.6.3) for clarity.

4.2 Theme 1 – Technology

Fewer comments on technology were solicited in phase two as the concept was considered to have been proven in phase 1. Participants were still invited to express any thoughts and feelings they had towards the technology and their opinions are summarised below.

4.2.1 Enjoyment, Satisfaction and the Benefits of Using Technology in Education

Students were positive in their view of the intervention and thought it worth pursuing in future. Students felt the avatar was helpful as it provided a focus for the simulation

"Well, it [the avatar] did [help] for me because I noticed that his lips were blue, and his fingers were blue… but when you can like physically see someone and what's happening it's a bit easier." [P020]

Students also commented on the fact that the technology helped to maintain their concentration for longer periods than other classroom based activities:

"It stops you getting bored really because you can forward it so many hours and see results and make the changes." [N005]

Students also valued the educational benefit of being able to experiment with specific treatments in a safe environment:

"And I think like when it came to prescribing stuff we picked something and then we were like, 'Yeah let's just do it'… we might have been a bit more confident just like doing it and seeing, it's just like trial and error [yeah] and you can't do that in real life because there's an actual patient." [P027]

Observational data audio recorded serendipitously whilst the researcher left the room revealed that students wanted to improve on their previous performance in the simulation.

They were both inspired to improve their performance and inquisitive to see how they may achieve this.

"Let's try again. I do like this….What drugs would you give him? If cephalosporins caused that [anaphylaxis], what would you give him? It's just interesting to know what we would do." [D010]

No fear of technology was expressed amongst the participants in phase two.

4.2.2 Real Time

Participants appreciated the real time nature of the scenario, particularly how the patient responded to interventions made by participants.

"You get like immediate feedback on the decisions that you make so, then obviously you can modify whereas if you're just talking about a scenario you don't necessarily know how your decisions going to affect the patient." [N006]

The ability to fast forward when the patient was stable was also cited as an important feature for learning:

"Yeah, not the concept because I feel that because it's fake, a simulation [laughs] you know like times, fast forwarding and all of that in real life you can't really [do that] yeah. But in real life at the end of the day you're looking after ten patients." [P014]

The element of surprise in the scenario also helped students to engage with the intervention more profoundly than a paper-based case study:

"It's like when you're given a patient case like say just an A4 sheet of paper like we haven't – like in previous IPE sessions and we've just gone through it like what you were saying very black and white of how the journey goes whereas with this it can chop and change like direction [yeah] of the patient journey can alter." [P020]

4.2.3 Care/engagement with VP

Participants demonstrated engagement and emotional attachment to the virtual patients through both observational and focus group data. Following the death of the virtual patient a nurse made the remark:

"*At least he didn't suffer…Think of it that way rather than prolonged"* [N010].

Situations involving high acuity and high risk also increased student involvement with the patient

"I think it was definitely good though to check like with his lips and his hands and stuff to see like and obviously when ours went red he went into anaphylaxis [yeah] that was good…" [N005]

"It made it seem like there was an actual sense of urgency." [P020]

Observational data demonstrated some students wanting further interaction with the patient, this was often rooted in clinical history taking or observing whether or not a patient is breathless whilst talking.

"I would like a little chat" [with the VP] [D010]

There was some degree of inauthenticity mediated by the scenario as students viewed the task as a learning opportunity which increased their risk taking behaviour because the patient was virtual as opposed to real.

"And I think like when it came to prescribing stuff we kind of picked something and then we were like, 'Yeah let's just do it' because like it's a virtual patient so you're like the worst that can happen you just reset it." [P027]

4.2.4 Authenticity of Communication

Participants were questioned regarding the long term future of the project and the ability to download the simulation as an app on their smart phones and then to be able to manage the patient remotely. The response was mixed with some participants questioning others' inclination to communicate remotely.

"so for me I think unless you're actually put in a room with them like we would have been today I don't really think it would work if you did it as like the app on your phone." [P012]

"I don't know. I'd be a bit sceptical because I think when you're together [in person], you communicate better." [N010]

Participants then reflected on some of the common issues with asynchronous communication they had experienced (Figure 4.1).

N010: ...I think it would be a lot harder; whereas, when you're communicating [face to face] about what you're doing, you can have feedback, from the people that are in that [other] profession, to come to the decision. You're helped in coming to the decision.

Res: You think it's difficult to communicate if you don't actually see someone?

D010: I think so, yeah.

Figure 4.1 Participant thoughts on effective communication

The issues explored included the notions of time and convenience, (asynchronous communication takes longer and does not account for an individual's current personal circumstances). And the convenience of having a succinct conversation and developing a plan based on the outcome.

"because if people were coming up with things they wanted to do, have you got the time to look at it and then treat the patient?" [N010]

Other participants alluded to the ability to correct misconceptions quickly in a group situation, whereas it would be more difficult and rely on others error spotting in an asynchronous environment.

"If an individual is doing it, the person might focus on some things that are not even the actual problem and even lose track on it. In a group like this [face to face], if they say something that devalues the actual problem, they might be corrected rather than individuals who might just take different directions altogether. Definitely, if it's done in a group where everyone can see each other, it's way better, I suppose." [P030]

4.2.5 Realism/Positioning

The realism of the scenario was primarily questioned by nursing students who have had the most practical experience of work based learning and assessment. Criticisms ranged from difficulty observing the patient and monitoring vital signs at the same time to queries regarding the biochemical response of the patient to oxygen therapy.

"I suppose it's difficult because you can't see the patient, so the treatment you're giving him, you can't see the benefits that it's having or not having. I think if it was a proper simulation with a patient [mannequin], you'd be able to identify things a lot quicker and then determine your treatment pathway…." [N010]

“you’ve obviously got your mannequin. You notice things with the patient, either picking up or deteriorating and so then that changes the pathway you go down. Whereas, I suppose, to have to flip back from one area to another area [it’s more difficult]... because with a proper simulation…Whilst you’re looking at the results for a blood test, you can’t see what’s going on with him.” [N010]

It was suggested that realism could have been improved by increasing the verbal responsiveness of the patient, participants also suggested that listening for breathlessness in the patient’s voice whilst having a conversation would be standard practice, suggesting attention should be paid to non-verbal behaviours of patients in future iterations.

Res:	Absolutely. What I loved was that you said you [D010] wanted a little chat with him really, just to try and find out a little more about him.
N010:	Well, then we would have been able to determine if he was breathless when he was talking as well.

Figure 4.2 Interaction regarding non-verbal communication of the avatar

Nursing students felt that a real patient would respond to oxygen therapy in a more timely manner:

“you get the boost pretty much as soon as you start the oxygen, don’t you? It then levels out a bit.” [N010]

“Do you know with the oxygen I wasn’t sure if it would usually start to go up a bit quicker on oxygen therapy?” [N004]

Pharmacy students tended to be more positive with regards to the realism of the virtual patient, citing physical characteristics of the avatar as making symptoms appear more realistic than textbooks ever could.

"I especially liked the small differences that you can actually see on the patients face like the fingers staying blue but then the lips going back to a normal colour like you were saying like we've stored him to central cyan [cyanosis], yeah that was it." [P020]

Participants also appreciated the challenge of having to wait for blood results as a good way of replicating the reality of the ward environment.

"Well that [waiting for results] is realistic though because some tests do come back a lot quicker than others, so you could do your bloods send them off urgently and get some results straight away or within half an hour and then others you could be waiting two, three, four hours." [N003]

4.2.6 Technological Improvements

Participants were keen to have their views heard on how the technology could be improved and implemented in future, a total of ten separate suggestions were made amongst 26 responses to questions in this area. The views are summarised in the table below:

Suggested Improvement	**Number of times mentioned by participants**
Augmented Reality difficulties	6
Interface improvements	5
Crashing (specific bug in interventions 1 and 2)	5

Further questions	2
Rewind button	2
Dosing/administration improvements	2
Size of hardware screen	1
Inappropriate verbal response from VP	1
More drugs	1
Ability to observe and read vital signs concurrently	1

Table 4.3 Suggested improvements from the second phase of the study

Augmented reality was the most frequently cited irritation in phase two, it was viewed that this could affect group dynamic as participants had to face in the same direction to observe the patient.

"Lets try again. I do like this. Where has he gone? Where is he? There he is." [D010 struggling to locate patient due to augmented reality]

P023:	…because it's just like random but the VR [sic] doesn't really add to anything and I noticed that from the pilot [previous experience with similar technology]…I mean it could just be like a normal not moving patient.
N004:	It made it harder as well to work as a group.
P023:	Yeah everyone has to face one way.

N004: In our group because it [interface] sets once you first turn it on so, then when you try to work together and then if you want to see the patient you've suddenly got to adjust the screen to be able to [see them]….If it was set it would be easier wouldn't it?

Figure 4.3 A brief interaction regarding to usefulness of augmented reality

Interface improvements were suggested although some could relate to the familiarity of students with the technology. These included using more windows-like tabs, being able to view two parts of the system contemporaneously and simplifying the ability to conduct multiple assessments on a body system at the same time.

Participants requested improvements to the units of dosing (grams was unavailable for paracetamol, intravenous aminophylline had to be prescribed in mL/h). Participants also wished to prescribe drugs which were unavailable in the database (Sodium chloride as intravenous fluid and as nebuliser alongside systemic chloramphenicol) (Figure 4.4).

P014: And also, the drugs some of the drugs were not on there, yeah.

P017: Yeah.

Res: So, you wanted to prescribe some drugs that weren't there. What was it? The drug that you wanted to.

P013: Well we couldn't find the saline and sodium.

P014: So, I think one of the antibiotics wasn't there was it?

P013: Chloramphenicol.

Figure 4.4 Participants discussing drugs they would like to see in the simulation

Participants also complained regarding an inappropriate verbal response from a patient (Figure 4.5).

P012: And more responses from him, I know that's a bit difficult but [yeah] you'd ask him if he was alright he'd say, 'Yes' and then the next minute his heart rates at a hundred and something and he dies [laughs].

P014: [laughs] yeah.

P013: He died saying he was fine.

Figure 4.5 Inappropriate verbal responses from virtual patient

4.2.7 Technology as a Superior Method of Withdrawing Information.

Participants thought the technology was successful in eliciting specifics of information required for the case when compared to more traditional teaching methods. This was related in two separate ways: pharmacists were impressed with the technology's ability to force them to make a decision.

"*Well in the real world you can't just say ACE inhibitor [yeah] you have to say it as a specific [drug] don't you."* [P013]:

Other participants argued the simulated aspect of the technology helped them to recall practical knowledge far more clearly than a straightforward question without context would do. This was especially seen when acute crises occurred in the simulation.

"So, like if somebody said to me, 'What you know about anaphylaxis?' I would freeze, and I'd be like, 'Well I know nothing about anaphylaxis' but if I saw the signs of anaphylaxis on a patient I'd be able to tell you that, that was what it was, and this is how we treat it, and this is what we do. So, it's just like a better way of withdrawing the information that I do know whereas paper-based systems aren't as successful in doing that." [N006]

"I'd definitely agree with that, yeah." [P020]

4.3 Theme 2 – Education

Participants cited that the technology and simulation had some specific and novel educational benefits. Some of which could be termed as 'paradigm' experiences (97). These ranged from the specifics of education mediated by the technology, through to learning explicit knowledge from one another in the simulation.

4.3.1 Technology and its' Relationship to Education

Participants commented on the ability of the technology itself to facilitate educational paradigms. A particular advantage considered was the ability of the simulation to give students immediate feedback in real time.

"*You get like immediate feedback on the decisions that you make so, then obviously you can modify whereas if you're just talking about a scenario you don't necessarily know how your decisions going to affect the patient."* [N006]

The problems set by the technology were considered to be appropriately rigorous and challenging to stimulate students (Figure 4.6).

N010: Yeah, because it [the app] makes you think about what you're doing.

P030: Yeah, yeah.

D010: Even with the drugs, it's making you think about the antibiotics in that certain situation. You'll remember it now because you can apply it. You'll be like, 'Oh yeah, when I was in that room and doing that simulation, we gave him cefotaxime when he had a penicillin allergy.

Figure 4.6 Students commenting on the ability of the app to convey learning experiences

Also the time between administration and the onset of drug action in the simulation was cited as a benefit, students valued the learning experience but also questioned their own assumptions during this phase of the simulation.

"[The antibiotics take at least six hours to kick in.] That's the thing. I mean they say two to three days when you're in the community on oral tablets, don't they?" [N010]

"We didn't know to be honest like we gave them antibiotics…and it just didn't do anything to the infection and at that point we were looking at the NICE guidelines and at that point you'd ask the teacher [laughs]." [P023]

One other perceived benefit was the reproducibility of the simulation, this was cited as being vitally important in the context of different student experience in experiential learning placements.

"I think it shows like realistically because I think in all of our training who are on the same course we all got different placements so we know different things…but I'm sure some of you have been on medical wards a lot more than I have so could deal with a long term effect but maybe not the immediate." [N004]

4.3.2 Educational Uses

Comparison to Experiential Learning

Pharmacy students felt that the simulation would be of most benefit to themselves amongst the healthcare students. It was insinuated that this was due to lower quantities of simulation and experiential learning in the MPharm.

"When you see it in placement, you would understand it much better. We don't really have hands-on in placements as the nurses do…" [P024]

"I guess it would be a good app for pharmacy students, I suppose." [P030]

In comparison to other placement experiences there was a mixed response to how authentic the simulation was, some participants agreed that it was similar to other experiences, however others commented on the ability to hyper-observe the virtual patient.

[responding to similarities with previous placements] "I don't know though because it's only like one patient and we'd have…six to eight as a standard to look after so, like it's easy to monitor how everything happens to this one patient but we wouldn't do that realistically" [N003]

Participants also commented upon the differing paradigms of educational practice between professional groups, and how the simulation helped to bridge those gaps, hopefully improving both knowledge and teamworking skills.

"I think the software was kind of like a nice halfway house between like the front line training that nurses have like [P026] was saying and the very much theory-based knowledge that pharmacists have it was like a nice place for us both to meet and to be able to execute decisions." [P020]

Pharmacy students argued that they would be satisfied with taking part in the simulation if clinical time was unavailable:

"Yeah… I would be happy with that as a substitute for clinical time if we couldn't get the clinical time." [P013]

Other participants thought lessons learned from the simulation would prove to be valuable in future practice placements.

"I think it's good for us though as well because obviously the pharmacists are doing their job and like prescribing and everything but it helps us to recognise different drugs…and dosages so that once we're then out on placement if we see a prescribing error whether it be from the doctor or whatever we can then highlight that, we can sort of recognise it before we administer it and pull them up on it so I think this sort of thing does help within that perspective as well for us." [N003]

Comparison to non-experiential learning

Participants compared the simulation to previous non-experiential learning experiences. It was cited as a novel improvement on traditional paper based scenarios. Participants argued the unpredictability of the technology increased realism above and beyond the traditional case study.

"It's like when you're given a case study…there's just the answer, there's just the natural kind of sequence that you go through and it's like you made the decision it's right or wrong then the next step is this happened, make a decision it's right or wrong. With this it's like okay well we tried this way lets try a completely different thing and although that worked mostly maybe something at the end went wrong so we can improve it if we start again and we try something else. It's the idea that like P027 was saying before trial and error gives you confidence." [P020]

The interactivity and the visual representation of a patient was cited as a positive with participants reporting improved engagement and realism.

"…I think it's definitely more engaging than I think the paper form people can just sort of switch off and just be like yeah whatever. Whereas with this because it's there and it's like an interactive type thing…it's definitely more engaging." [P025]

"I actually think all the paper based TRIPSE is much easier than this [okay] which is why this is probably better because it's more you know realistic and you draw the knowledge from different areas." [P023]

As can be seen in Figure 4.7 below participants felt the simulation helped them to articulate theoretical knowledge and put it into perspective. The potential for paradigm learning experiences such a death were cited as an additional benefit, with some participants visibly upset in observational data by the demise of the avatar.

Res: What are the advantages of this kind of way that you see compared to you know more traditional teaching techniques?

P014: The cramming because you cram, you forget like this one kind of puts it into perspective.

P010: You have to understand what…

P014: What you're doing, yeah.

P010: And then you can then translate it.

P012: Yeah, I guess we can see like what the drug actually does to the patient.

P015: Yeah and if its wrong then it sticks with you because they die.

Figure 4.7 Integration and application of knowledge with paradigm learning experiences

Another educational advantage cited by participants was the ability of the simulation to improve student confidence whilst being used as a revision tool.

P012: But then in a way it's quite good that we've done [the simulation] so far after it.

P013: No, yeah.

P013: Yeah, I agree with you, but I mean you could do it for any therapeutic block like your cardiovascular, nutrition.

P012: But like I think it was good that we did do this like almost a year ago now because…

P011: It refreshes you

P013: You know that some stuff sticks.

Figure 4.8 Ability of the simulation to facilitate revision and recall of knowledge

One final point raised by participants was the ability for the simulation to teach students soft skills such as prioritisation.

P013: I liked the importance of the you know when so, like respiratory if that's going south like you know about it [yeah] but if you've got a sore toe then, do you know what I mean like? Sort of like puts it into perspective like the severity of different, like how to prioritise when part of the bodies going wrong if that makes sense? [yeah].

Res: So, kind of like…

P013:	Your heart, and your lungs are something that you would maybe prioritise over the like dry skin or something.
Res:	So, it's almost teaching you prioritisation without explicitly doing it?
P015:	Would you eventually do it as like a full ward?
Res:	Yeah, possibly.
P015:	So, then you could like prioritise and if you do it wrong.
P014:	Oh that's, that would be good.
Res:	That's something we could do.
P016:	Then you can guess which people die first [laughs]

Figure 4.9 Participants postulating the ability of the technology to teach prioritisation

4.3.3 Educational Philosophy

Paradigms of educational philosophy were noted in the results, nursing students strongly spoke of education in terms of experience, reflecting the majority of their undergraduate study still takes place in a workplace setting. Medical students also actively reflected on experience but challenged experience 'for the sake of it', pharmacy students tended to talk of education in classroom setting due to their reduced exposure in undergraduate study.

Participants reported the simulation made them think about decisions or exposed them to situations which they had not encountered before. This suggests that the simulation forces students to reason at the higher levels of Bloom's taxonomy (68). This effect was reported both due to the technology itself and the design of the teaching session (Figure 4.10):

N010: I think it makes you think then when you're doing the different roles. It puts into perspective what's expected of people.

Res: Do you think the role reversal is a valuable thing then?

D010: Yeah.

N010: It also makes you think that when you're asking for something, you have to be aware of people's time restraints and what they've got going on.

Figure 4.10 Role reversal facilitating deep levels of thought

The technology itself modified participants classroom paradigms of how to prescribe, with students actively acknowledging they had to think of the best way of tackling a problem.

"*There's not always one way of doing something there are multiple ways*." [P026]

This was augmented by delays between prescribing and onset of action of the drug which again made students reflect upon and reconsider their prescribing decisions:

"When he got better but then got worse so then it made you think, 'Oh well what have we done wrong?' and it made you re think where you could have gone wrong." [P011]

Participants also reflected on the need for critical thinking in the simulation which was aided by observation of a patient's vital signs (Figure 4.11).

P015: I think especially if it's like outside of like say NICE guidelines which most cases in hospital you have to give another drug so, kind of like puts critical thinking into it.

P013: here you can see how your choices directly affect the patient if that makes sense?

N004: …which is something which makes you question whether it's because the antibiotics aren't working, they haven't given long enough…

Figure 4.11 Interaction detailing the advantages of immediate feedback with respect to drug choice

Evidence of paradigm experience

Participants suggested that the simulation could have acted as a paradigm experience – an event that they would never forget in future. When it was explained how the virtual patient died, students stated this would be something they always remember. This was supported by pharmacy students reporting key learning points from a similar event with an avatar in their previous studies.

P014: [referring to previous experience] I think I gave him vancomycin.

P016: And that was a shorter session as well.

Res: Yeah and you remember that still?

P015: Yeah.

Res: That you gave him vancomycin and he went red, you know what he's showing there is it's kind of quite a powerful learning experience for you then.

P013: Yeah.

P011: We aren't going to forget that now, what oxygen we give now.

P014: Yeah, yeah.

P016: Never give anyone 100% [oxygen] again [laughs].

Figure 4.12 Students speaking about previous paradigm experiences and their similarity to the simulation

Again pharmacy students tended to bemoan their lack of experiential learning whereas nurses framed their learning in terms of it.

Res: Yeah, absolutely I mean one thing I wrote down today is nurses have a lot of grounded knowledge so, you've seen things before and you're confident in dealing with them whereas pharmacy students as a whole…you know what to prescribe but you don't know what happens if you know what I mean?

P023: Yeah initially N004 knew how to stabilise the patient, we never [yeah] I mean when the patient comes in we don't really know what to do we just know like what drugs they're on and what drugs to give.

N004: I think it shows like realistically because I think in all of our training who are on the same course we all got different placements so we know different things…but I'm sure some of you have been on medical wards a lot more than I have so could deal with a long term effect but maybe not the immediate.

P014: No, so people [pharmacy students] wouldn't have so much experience you know it's rare on the placements. This is a better way really because I've only had about one or two and they were one-week placements.

Figure 4.13 Students reflecting on their usual learning experiences.

4.3.4 Future Use

Participants believed the technology would be suitable for many different types of clinical situation.

"Yeah, …you could apply it to anything." [P011]

They also envisaged its use in inherently different ways where rather than speaking to a patient, participants could speak to another healthcare professional.

"What about talking to the doctor? But I don't know, like if you have like speaking to the doctor so like you have a list of questions like, 'Why can't we prescribe this? Can we change it?'" [P014]

When specifically questioned regarding the mobile use of the technology, most participants agreed that it would be educationally beneficial. One participant raised the possibility of students disengaging with this format due to competing timetable pressures, exactly the scenario it was designed to avoid.

"My only like thing with that [mobile app] is we have so much stuff to do I don't know whether it would be overlooked if it wasn't like timetabled to come in and physically have to be somewhere." [N006]

Overall the simulation appeared to be of educational benefit for students both in terms of teaching practical skills required in the management of COPD and for improving collaboration and communication between professional groups.

4.4 Theme 3 – Collaboration

4.4.1 Teamwork

The simulation and technology naturally facilitated teamwork and collaboration between participants. They relied on each others' knowledge and experience and deferred to each other as appropriate to derive a good outcome for the patient. When directly asked 'what makes a good team?' participants gave a number of roles and characteristics which they believed important for any team. These included a leadership, respect, good listening skills, communication, rising above conflict, and awareness of one's own role.

"You're not going to get on with everyone in the team and so if you've got conflict, I think you have to not let it affect the team. There are loads of different personalities and you do experience that with the hospital staff, don't you?" [D010]

"*Oh yeah, you clash with people, don't you? We're there for the patients at the end of the day and the treatment that we do is for the patient. If we don't get on whilst we're doing it, then we do what you ask and vice versa. I suppose it's about having that mutual respect for everybody and everybody's role. Everybody is important in what they do and without each other, we wouldn't be able to do what we do. [PHARMACIST SAYS NOTHING….]"* [N010]

Pharmacy students tended to concentrate more on generic qualities in their responses whereas nursing and medical students related responses to their experience of working in teams in a care setting, thus producing more nuanced and pragmatic tips for good team working.

Good examples of teamwork were often observed in the form of 'helpful knowledge' shared between participants, relating directly to the 'learning from' portion of the CAIPE definition of IPE (169). Even when attempting to role play another professional in the group participants tended to revert to their own profession if they had knowledge which would help the management of the patient.

"At this moment there has been a high level of collaboration between students. N010 & P030 have been quieter and less forthcoming than D010 who is guiding the others through the process of diagnosis. D010 has certainly reverted to type." [Observational data]

If participants were uncomfortable making a diagnosis or suggesting a treatment, a much more collaborative and shared decision was taken between participants in the group (Figure 4.14).

D010:	"would we not just give penicillin if he has a bit of a rash?"
N010:	"I wouldn't feel comfortable prescribing penicillin"
D010:	"I'm worried he might have a weird anaphylactic reaction"

Figure 4.14 Example of collaborative decision making process

Participants actively acknowledged the shared decision making process but then vocalised whether or not they felt competent to take part in the decision. Participants stipulated where they viewed their own competency ending, and any safety nets they would deploy to check another's decision.

"I think in terms of like deciding to prescribe it was like a collaborative thing. But for me…I don't usually get involved in what drug to prescribe over another,…that's not my decision so, I sort of left that to these guys [pharmacists] because as long as they're not allergic to it as far as I'm concerned if its doing the right thing then I would just give it." [N006]

4.4.2 Communication

Participants viewed good communication skills as being essential for collaboration amongst healthcare professionals. Face to face conversations were regarded as the most effective method of achieving a solution, with a number of benefits such as solving errors in real time cited.

"Yeah, because even if you bleep a doctor on the ward, you'll see them and tell them your problem and then they'll come round. You then kind of expand on your problems a bit more and then they go and see the patient visually to then decide on a treatment plan. I don't know. It's like taking it away from all being together to just going via an app." [N010]

Participants also cited problems with miscommunication if people do not communicate in a face to face setting:

"In a group like this, if [a person] says something that devalues the actual problem, they might be corrected, …if people work individually they can take different directions altogether. Definitely, if it's done in a group where everyone can see each other, it's way better, I suppose." [P030]

Participants also related this to the simulation itself citing the benefits of face to face meetings over mobile technology mediated virtual environments:

"I think going back a little bit I think it was definitely best to keep it as scheduled sessions because I think like a big thing of IPE is that communication aspect, like talking to each other, finding out what other people would think of a scenario before you process it." [P026]

Pharmacy students were observed to actively avoid communication if they felt unable to answer a direct question. This behaviour could be categorised as evasive and distraction (Figure 4.15).

D010: [to P010] "What would you recommend for *H.influenzae*?" P010: [Does not respond for some time] "not sure" D010 then struggles with a drug name, looks to P010 for help [P010 slightly ignores this request]
D010: What drugs would you give him? If cephalosporins caused that, what would you give him? It's just interesting to know what we would do? [LONG PERIOD OF SILENCE]

Figure 4.15 Examples of pharmacy students actively avoiding communication where they are unsure of the answer

When questioned about the key learning outcomes of the scenario one participant responded with the suggestion that the main aim was to teach collaboration, suggesting the technology would be a useful format for future interprofessional learning.

"[in response to a question re main learning outcome] I think just the general collaboration of different disciplines." [N003]

4.4.3 Professional Debate

Observational data failed to show participants actively disagreeing with each other as part of a team. However professional debate and firm guidance were both observed and alluded to in focus groups. Most participants felt this fell under the terms of debate, rather than active disagreement (Figure 4.16).

Res:	Did you feel you had to disagree with each other at any point in the scenario?
P023:	Not really.
P027:	No.
N004:	Not really.
P026:	There was one just like…
P022:	Maybe we should have?
P026:	It was more just like deciding what we think is best for the patient it's not really disagreement…

Figure 4.16 Students vocalising their disagreements

Observational data revealed students disagreeing a little more often than they admitted to in focus groups. However the disagreement was almost a subconscious level where students with greater knowledge advocated a different path to take in the simulation. Normally these requests were acquiesced without a long debate.

N010:	Explains to P030 how a nurse would assess a standard presentation (and be 1st on scene)
P030:	Thinks of questions to ask patient, N010 and D010 steer her in a different direction

Figure 4.17 Example of a professional steer

Students actively acknowledged the necessity to disagree with colleagues in practice, and the ability of IPE interventions to mimic these situations.

"I think in IPE especially because we need to challenge someone if they disagree with us so, I think this is a key part of it and also like you know consolidating in your knowledge whether to actually say what you know." [P010]

4.4.4 Reliance Upon, and Benefit of Other Members of the Team

One of the most collaborative behaviours facilitated by the simulation was a reliance on and acknowledgment of the benefit of having other members of the healthcare team present. Participants actively sought out the opinions of others in the simulation itself and then enthusiastically advocated the benefits of multi-disciplinary working in the focus groups.

"…I feel like we constantly like bounced ideas off each other and we…always referred to each other where we knew that where our, where the knowledge of our discipline ended someone else's began." [P020]

Some pharmacy students were particularly impressed with the knowledge of nursing students:

"Just like with the phrase like, 'Just a nurse' like that's the whole point of IP like it showed us all that actually we've all got different areas where we're really good at. Like you [nurse] had knowledge on stuff which I was just like, 'Oh that's sick' like [laughs] I don't know that…" [P026]

Nursing students returned the favour with an acknowledgment of their limitations.

"I think that was definitely good like I knew that they [pharmacy students] knew about analgesia – is that how you say it? Analgesia." [N006]

A truly collaborative example could be seen in the following quote:

"Yeah so, initially N004 did most of what happened and then later on when we had to prescribe the antibiotics that was mainly all we knew about." [P023]

Participants also cited an inability to know everything about a situation, thus reinforcing the requirement for differing perspectives:

"I don't think one person would know everything that can happen to one patient that's not realistic." [P023]

Reliance on others was sometimes framed in negative terms, rather than being actively related to the simulation this was due to previous experiential learning. This was characterised by stereotypical perceptions of what a students role is.

"But then that would be down to the doctor's decision for prescribing it and if we weren't comfortable, we'd question it but then we'd also say, 'Crack on, doctor.'" [N010]

Previous experiential learning was cited as a benefit in some instances

"Yeah, and I think you do bounce off each other with ideas when you're in placement, I think, because you can see what's going on." [N010]

A final note was that participants felt more confident with their colleagues in the room with them.

"I think you feel more confident with this knowing that you've got the team and it's not just you sort of thing." [N003]

4.4.5 Other Examples of Collaboration

Participants felt the simulation gave them experience which would be important in their future working careers.

"If we're then out on placement and we see a prescribing error whether it be from the doctor or whatever we can then highlight that, we can sort of recognise it before we administer it and pull them up on it so I think this sort of thing does help within that perspective as well for us." [N003]

The role reversal asked of some participants led to a greater awareness of the pressures and stressors of that particular job:

"I think it's really good and beneficial because you can appreciate what other people do. When you do the role reversal, I think it opens your eyes to what we actually don't know about what people do…. It also makes you think that when you're asking for something, you have to be aware of people's time restraints and what they've got going on." [N010]

Medical students acknowledged the hierarchical relationship between their profession and others, as well as citing hierarchies within medicine itself.

"I think you get a lot of hierarchy in Medicine as well. Unfortunately, you get the medical students who do think they are already doctors (but not me). They say, 'Can you do this?' or 'Can you do that?' You think, 'You're a medical student.'" [D010]

In terms of collaboration, a nurse gave her view the main underpinning element necessary for collaborative work in healthcare:

“I do think it’s about being aware of what your role is and what other people’s roles are because when you’re on your ward round and the doctors are demanding all these things from you (because they do, don’t they?)… It’s difficult then to keep up with what you’re doing with each person. You start getting confused about how you’re treating your patients.” [N010]

4.5 Theme 4 – Intrinsic Behaviours

Participants demonstrated a number of behaviours which would were deemed to be useful for their future careers including appropriate time management, bravery, critical thinking in decision making, and improved confidence. In addition to this less suitable behaviours were demonstrated such as lack of patience, resistance to responsibility and disappointment at failure. Observational recordings revealed less desirable behaviours in more detail than focus group data.

4.5.1 Positive Behaviours

Care/engagement with VP

Participant care and engagement with the virtual patient has previously been discussed in 3.2.5, 3.5.1 and 4.2.3, emotional attachment to the avatar could be seen from quotes such as "*Poor bloke!"* [P030] when participants were discussing the virtual patient's death in the simulation.

Experimentation and confidence

Participants reported that the simulation allowed them to experiment with different treatments for their virtual patient in a manner which could not be replicated in an experiential environment. The ability to change decisions without causing real patient harm was cited as a strong method of improving clinical reasoning skills.

"*I thought it was an easy way into it because yes, we did [laughs] kill the patient [yeah] but we haven't actually killed the patient and you learnt from that without hurting someone, if that makes sense? So, that's the best way of doing it really."* [P013]

The fact that the virtual patient was not a real person was cited as a method of improving student confidence as they were more prepared to experiment with different treatments.

"I think this is better though, well not better but like good because you're more confident with your choices because it's not an actual person." [P015]

This somewhat lessened the fear of making a fatal error, however participants still cited that this would be a paradigm experience with regard to future practice

"Yeah and if it's wrong then it sticks with you because they die." [P015]

Participants cited that in reality despite being placed in charge of patient care in experiential settings they were always subject to supervision, thus they had to defer important decisions about patient care to qualified colleagues. The technology allowed participants to experience the responsibility of looking after a patient without supervision.

"I think as well it was nice to be in charge of the patient because I am regularly in charge of a group of patients but when I say that in practice I'm not really in charge of them there's a nurse whose above me whose monitoring them all the time, there's doctors all around and to be the one whose actually making the decisions and seeing the effects of that is really beneficial because in six months' time I am sort of going to be that person." [N006]

This sense of a burgeoning professional identity and responsibility was mirrored in other participant's thoughts regarding their previous learning experiences:

"Yeah, I think your confident to a degree but as well obviously us being in practice we've seen that people have had the treatment and they've still just gone off and how quickly they've gone off so, you can be confident to a point, but you can't be overly confident because anything can happen, and you see that in reality." [N003]

Participants were confident with respect to clinical reasoning and prescribing skills with responses such as:

"I didn't feel horrendous in prescribing." [N010]

It was noted however that confidence improved when a positive response to treatment was observed in the virtual patient, when the patient did not immediately improve participants started to doubt their decision making process (Figure 4.18)

Res: Once you'd made the decision did you feel confident in what you'd done? So, you've already said you were hopeful.

P013: Depends on how he reacted.

Res: Depended on how he reacted, so it was all dependent on [yeah] what was going on there.

P013: So, like when we decided the oxygen obviously his stats were going up we were like, 'Oh well that was a good, like that's what we wanted' but then obviously when we were experimenting with the antibiotics a bit.

P015: But, yeah, but we were still, I think we were still more cautious with them anyway because there was loads of options [yeah] so, yeah.

Figure 4.18 VP responses are important to develop confidence in clinical decision making and prescribing skills

Finally participants appreciated feeling as though they were part of a team, with the collective responsibility of caring for a patient improving their confidence

"I think you feel more confident with this knowing that you've got the team [yeah] and it's not just you sort of thing." [N003]

4.5.2 Leadership

Use of time (time management)

Participants did not actively discuss their time management skills in relation to patients however good time management was inferred by participants feeling relaxed at various points in the simulation.

Bravery

Participants felt that the simulation helped them to be braver than usual with regard to their decisions surrounding the treatment of the patient. The technology itself inherently facilitated this by providing a real time challenge via deteriorating vital signs. Participants also cited one of the underlying principles of IPE as being able to, and having the confidence to challenge other professionals regarding patient care (Figure 4.19).

Res:	That's interesting. Do you think this has forced you to be brave with your decision making then?
P013:	Braver.
Res:	Braver than you would be in say a class [yeah] if I was saying who would give this [yeah], who would give that?
P010:	I think in IPE especially because we need to challenge someone if they disagree with us so, I think this is a key part of it [yeah] and also like you know consolidating your knowledge whether to actually say what you know.

Figure 4.19 Participant conversation regarding bravery in both decision making, and challenging other healthcare professionals

The simulation also aided participants to attenuate their risk taking behaviour when attempting the simulation for a second time, in this respect participants were still 'brave' with their decision but not foolhardy (due to previous experience).

"If I fast forward him a little bit (but not an hour)..." [D010]

(Forced) decision making

Participants articulated three general responses towards being forced into making a prescribing decision for the virtual patient. Firstly, because they were forced into a decision by the gravity of the situation, and they viewed themselves as unfamiliar with the process of making a decision their general feeling was that they were heading into the unknown, or more optimistically hopeful that they made the right decision (Figure 4.20).

Res:	Making the decision to initiate the treatment – I'm talking to you two [nurse and doctor] because you had quite a nice conversation about most things. How did it make you feel having to make that decision?
N010:	I suppose, for me, it was like the unknown.
D010:	Yeah, it was quite unknown.
N010:	You know you need to prescribe antibiotics but...
D010:	I didn't know which one [laughter].
Res:	When you were prescribing something or initiating treatment how did that make you feel? Because I kind of noticed things about you, how you were actually making that decision.
P013:	Psychologically? [laughs].
Res:	Yeah.
P014:	We were hopeful.

P016: So, we didn't like know what to expect.

Figure 4.20 Examples of how participants felt regarding their decision making skills

Participants then revealed different depths of engagement with the decision making process. Some thought deeply about current guidelines and how to apply them to a patient, whereas others took a more pragmatic approach involving finding out what options they had available to them (Figure 4.21).

P010: I think you can like go back to pharmacology and pathophysiology so, do that first and then you would think about you know like NICE guidelines and everything because that's just kind of an algorithm.

Res: So, you were thinking quite deeply?

P014: I did not remember that NICE existed [laughs].

P013: What? [laughs].

P014: I was just like, 'Okay so, we have like an antibiotic' lets check in the BNF.

GF: No, no that's, that's really interesting because you know it's you know it would be interesting to see how many junior doctors think about the NICE guidance when they're making a prescribing decision. You know if you're in you know…

Figure 4.21 Differing thought processes regarding prescribing decisions

One final point pharmacy student participants made was that the simulation was useful for them to contextualise the time pressure regarding prescribing in a sub-acute hospital setting.

"I think it's made me realise how important it is to make your decision quite fast in real life."

[P016]

Patience

Participants demonstrated patience to the benefit of their virtual patient when they waited through difficult periods in the simulation where the VP appeared to not be responding to treatment. When questioned further on this they came up with a number of situations where they thought patience was a useful skill for a healthcare professional.

"[in response to the patient not improving within two hours of antibiotic administration] Which is something which makes you question whether it's because the antibiotics aren't working, they haven't given long enough [yeah] or do you know what I mean?" [N004]

Participants also recognised the ability of the simulation to make them hyper-observe their patient, and some of the consequences of this behaviour:

"you wouldn't look every single hour or every 30 minutes at what their heart rate was doing or whatever you'd look every couple of hours [yeah] or four hours like as you got around to it.." [N003]

Participants also cited the necessity of being patient with colleagues and understanding their pressures as a method of improving teamwork in a ward setting:

"I think it's not necessarily always understood by people requesting tests and things… I think we need to be patient in what we're doing because we've got to treat seven patients some days. You have to prioritise who is more important with their condition. I think it is difficult but then in the same sense of when you're being badgered for tests, and this, and that, you're diverting yourself away from the patient that needs you more." [N010]

Nursing students particularly cited that they felt undervalued by other healthcare professionals in certain situations, and they had to be patient with these negative attitudes.

"Yeah with and you know as a nurse with other healthcare professionals sometimes they don't respect that you know what you're talking about, that you've seen similar situations, that you've experienced it before and the phrase, 'You're just a nurse' has been said more times before so patience in that respect is necessary." [N006]

Participants also cited the technology itself as being useful to teach students about the importance of patience with fellow healthcare students in order to provide an optimal patient outcome.

"I think the software though was quite good for developing our patience because if none of us knew the answer so say I wanted to go and figure out which antibiotic was good for this specific species the nursing student I was with didn't really know much about that I didn't know exactly what to do but she was patient with me and allowed me the time to search through the resources that I was familiar with, I'd then come back to her with an answer, we'd talk about it say, 'Does this sound right? Do you think it sounds right?' and then we make the decision and then carry on with the patient so, that was good." [P020]

Calmness Under Pressure

Some participants actively denied feeling any pressure in the simulation, in stark contrast to others, seeming to exude a form of calmness through proceedings (Figure 4.22)

Res: Did you feel pressured at any time in this scenario, like you didn't have enough time or anything like that?

D010: No (x 2).

P030: There was time [laughter] [28:45 – participants over talking].

N010: There was no pressure.

D010: No pressure.

Res: You felt it was quite calm at the time?

N010: Yeah.

Figure 4.22 Students exuding calmness in the simulation

In particular participants appreciated the opportunity to take their time to think about the situation when the virtual patient was not responding as they expected.

"I don't know because we knew he was stable so [yeah] there was no like sense of urgency to the event [yeah] so, it gave us time to sort of sit back and evaluate the situation." [N006]

The varying skill sets and experiences of the participants were also cited as a mechanism which forced participants to act in a calm way taking into account differing perspectives of the situation:

"Yeah, I think definitely you know I think because everyone has got such different skills and there'll be things that like you'll be like massively like they've got like expertise on it whereas we're in something completely different so, were trying to get our point across and say like,

'No, this is what you do' but from your point of view it's like completely different so, you've got to like I don't know take a step back." [N005]

Students also exhibited calm characteristics in acute situations based on their previous experiences, nursing students particularly focused on their practical skills as being a method of revealing their knowledge in greater detail than in classroom settings.

"So, like if somebody said to me, 'What you know about anaphylaxis?' I would freeze, and I'd be like, 'Well I know nothing about anaphylaxis' but if I saw the signs of anaphylaxis on a patient I'd be able to tell you that, that was what it was, and this is how we treat it, and this is what we do. So, it's just like a better way of withdrawing the information that I do know whereas paper-based systems aren't as successful in doing that." [N006]

4.5.3 Followership

Seeking reassurance

Participants rarely looked for reassurance in this part of the study, however when faced with a difficult challenge and appearing to struggle for an answer, participants cited that they would look for help. The pharmacy student group looked most frequently to the researcher for reassurance.

"We didn't know to be honest like we gave them antibiotics like two antibiotics and it just didn't do anything to the infection and at that point like we were looking at the NICE guidelines and at that point you'd ask the teacher [laughs]." [P023]

Students actively seek frequent confidence boosting and reassurance from the facilitator. [Observational data of pharmacy-only group]

Refer to Senior

Participants were asked if there was any point in the simulation where they would have requested help from a more senior practitioner. The general consensus was no in the current scenario, however they were not averse to requesting help if required. This was related to previous experiences in workplace settings (Figure 4.23).

GF: In reality, would you wish to confide in a more experienced practitioner, if you were faced with a situation again?

N010: I don't know. I wouldn't necessarily say so.

D010: No. If we hadn't fast forwarded and then he was going downhill rapidly, then I would have got senior help but otherwise, no.

N010: It's like I'd do what I was doing and then I'd come to you [doctor] and say, 'We've done this but there is no difference.'

D010: If I didn't know, then I'd go to consultant!

Figure 4.23 Participants discussing the need for senior support

Cautiousness

Cautiousness was demonstrated when participants took a long time to make a decision which may have resulted in patient harm. Observational data in the pharmacy only group revealed a particular tendency to worry about the minutiae of the case to the detriment of the patient:

Students are finding it somewhat difficult to make decisions e.g arguing over frequency of dosing. [Observational data]

Students appear to spending a long time agonising over decisions which don't really matter. [Observational data]

However cautiousness was not strictly limited to pharmacy students, and in some cases could be viewed as engagement, empathy or even hopeful behaviour with the virtual patient:

Students have discussion regards fast forwarding for an hour, and decide to do so. "Hope he'll be alright." [Observational data from Multi-disciplinary group]

This was demonstrated in focus group discussions when participants were asked how having to make a prescribing decision made them feel:

GF:	When you were prescribing something or initiating treatment how did that make you feel?
P013:	Psychologically?
GF:	Yeah.
P014:	We were hopeful.
P016:	…we didn't like know what to expect.

Figure 4.24 Participants felt hopeful as opposed to confident when prescribing for their patient

Resistance to responsibility

When asked to perform as a pharmacist a medical student became somewhat defensive and fairly honest in their opinion of their own ability. Two particular occasions highlighted resistance to the responsibility for of being the expert in medicines:

"Well I know nothing about drugs so good luck with that!" [D010 response to being asked to role play the pharmacist]

"I'm no good at drugs" D010 then throws the BNF in P030's direction. [Observational data from MDT group]

4.5.4 Negative Behaviours

These behaviours did not serve any useful purpose for the functioning of the team and could be detrimental to patient care and interprofessional relationships.

Lack of Patience

Participants demonstrated a lack of patience when they did not leave enough time for any intervention to benefit the virtual patient's condition. Lack of patience appeared to be related to confidence in clinical reasoning skills and previous experience. Observational data revealed impatience amongst both multi-disciplinary and pharmacy-only groups.

"20 minutes after prescribing oxygen, students are still dissatisfied with the vital signs and O_2 sats and decide to increase dose to approx. 33% [critical detrimental action]" [Observational data of multi-disciplinary group]

"Group 2 tended to change the doses of drugs they were prescribing frequently." [Observational data of pharmacy only group]

Lack of patience often resulted in a detrimental action for the virtual patient, one of the most common prescribing decisions taken was increasing the concentration of oxygen beyond the safe limit of 28% for a patient in type II respiratory failure.

"It's just you've fallen into the trap of saying, 'That's not worked yet' and you've still got to give it a little bit more time to carry on. You just didn't give it enough time for the oxygen to work, to be honest, which again is about experience." [Researcher de-brief of MDT group]

When questioned as to why they increased the concentration some groups actively admitted impatience, with the caveat that they learned from their mistake (Figure 4.25).

GF: Because why did you go up to 30? [% oxygen concentration]

P015: Because it was going up too slow.

P013: Yeah.

P018: Yeah.

Res: Because it was going up too slow.

P015: So, I was like, 'Fill him up' [laughs].

GF: So, what's that taught you then?

P013: Don't do that [laughs].

Figure 4.25 Impatience with the benefit of oxygen

Participants (especially pharmacy students) actively acknowledged they found it difficult to be patient with their prescribing decisions. The simulation technology itself was cited as a potential reason for this, because despite it running in real time participants still expected an instant response (Figure 4.26).

Res: Sometimes you have to be patient in healthcare. And did you find that easy?

P013: No.

P016: No.

P013: Not when it's online, you think that it's going to be faster do you know what I mean? Does that make sense? Like you did emphasise it was real time, but still like in my head because it was virtual it wasn't real time.

Figure 4.26 Acknowledgment of impatience from pharmacy students, with a caveat relating to the 'instant' nature of technology

Deference

Active deference was observed infrequently in this part of the study with most groups taking a shared responsibility for the virtual patient. Deference tended to be observed when students were taken out of their comfort zones, and most commonly was related to gaps in knowledge. For instance, in the group which was asked to role reverse the pharmacist (playing the role of nurse) asked the doctor (playing the role of pharmacist) to interpret an X-ray.

P030: Asks D010 about CXR [observational data from MDT group]

A parallel phenomenon to deference was the active abnegation of responsibility for a given area. This was observed when the doctor (playing the role of the pharmacist) became frustrated whilst searching the BNF, and threw the book in the direction of the pharmacist (playing the nurse). This behaviour will be explored in more detail in section 4.6.1.

Confusion/ Panic/ Pressure

A majority of participants felt the simulation pressurised or stressed them at some point in the scenario. This was most frequently reported when the patient was acutely unwell or dying as the participants felts some responsibility for this (Figure 4.27).

Res: Did the scenario pressure you at any point?

P011: Well when he was dying it did.

P012: Well, yeah but [laughs].

P013: Not like the pressure if it was a real person dying.

P011: Yeah.

P013: And it was on your head.

Figure 4.27 Participants acknowledging responsibility for the virtual patient

Participants felt the technology's use of assets such as alarms when a patient was unwell, helped to suspend reality and increase the pressure of the situation.

"When like the sounds of the machines actually beeping and all that it made it realistic, it made it seem like there was an actual sense of urgency, so you had to act quickly, I thought that was a good aspect of it." [P020]

Participants also reported feeling anxious when the prescribing decisions they made were having no effect on the patient.

"Well like when you've kind of done something and just don't see a change and you're like what do we do now? So, it's like we need to become like independent to the point where you don't get like instructions on how to deal with people, you have to figure it out yourself because we were just sat there for a bit like, 'What now?'." [P027]

"Well I think…we made the dispensing error yeah and no one noticed so, it was frustrating seeing their blood pressure rising and not knowing why." [P022]

The ability to 'fast-forward' time was also described as a stressor by participants, as they would be unable to intervene if a patient deteriorated (Figure 4.28).

Res:	…did you feel the pressure?
P013:	I did, yeah.
P015:	When we were skipping forward.
P013:	When we were fast forwarding, we'd given him the antibiotic and everything was still going pear shaped and I was like, 'I don't know what to do' [laughs].

Figure 4.28 Students acknowledging the pressure of fast-forwarding the programme

Pressure was also conflated with confusion as to what was actually happening with the scenario. If the patient deteriorated following an intervention some participants started to feel somewhat helpless (Figure 4.29).

Res:	So, for instance you would have prescribed an antibiotic, both of you and then his temperature carries on going up, how did that make you feel?
P013:	[Laughs] Not good.
P015:	Caused a lot of stress.
P018:	Confused.
P013:	[laughs] yeah.
P023:	…yeah, I mean we picked the antibiotics based on the guidelines, but they still didn't work so then [yeah] we were just like not really sure.

Figure 4.29 Helplessness in the face of ambiguity

Pharmacy students also acknowledged that they felt the pressure of working in a team with a competitive intra-professional element:

"...like one person knows about a thing and the other person doesn't, it's like, 'did we go to the same class?' [laughs]." [P014]

Role-reversal also caused a degree of confusion amongst students as they were asked to act outside of their competency, meaning they dealt with the virtual patient in a very different way to their normal practise (Figure 4.30).

Res: having to play the role of the other professional, how did that make you feel?

P030: Not confident at all.

Res: Why not confident?

P030: Because I didn't really know how to start it off until she said I should start asking some questions because in my head, I would want to know the patient's name, the age and probably allergies. I would start thinking about their medications or why they came in and straight into their medication bit, after knowing what they are on and what they are suffering from. I think you go into a bit more detail when you're a nurse, I suppose. You're observing the patient more in detail, I think.

Figure 4.30 Reflection on having to play the role of another professional

Disappointment at failure

Disappointment and anger at failure was observed when the multi-disciplinary group decided to skip one hour forward after giving the patient cefotaxime and 40% oxygen (the patient died from anaphylaxis with respiratory failure as a result). This frustration was directed at the technology as there was no ability for them to correct their mistake or manage the situation.

"[patient dies after skipping one hour] Students visibly upset by this, "Can we not have another go?" "Did other people kill him?" There is some degree of anger that they didn't have the opportunity to observe his deterioration." [Observational data from MDT group]

Irritation/Boredom

A few participants exhibited signs of irritation and boredom in the simulation. This was expressed in some cases in response to a negative outcome for the virtual patient.

"Yeah, you'd notice if his obs were going down. That's the thing. It wouldn't just suddenly go down." [N010]

"I gave up…on the third one [after two patient deaths] I was like, no." [P014]

A nursing student did not say he was actively bored, but that he did feel disenfranchised when he (in his opinion) could no longer contribute to the simulation.

"I think, I think we would have if it was longer especially when we got to the stage where we were just waiting to see if he improved. I think if it went on too long but with just the one patient but I know for myself because at that stage I had no idea what the antibiotics that was down on the form then so, I was like so I didn't really have anymore to do." [N004]

Subversive Behaviour

One participant was observed to behave in a subversive manner to the detriment of their group, this participant overestimated their competency and actively misled other members of the group resulting in two patient deaths. Unfortunately this particular participant appeared not to learn from their mistakes.

"Group with P020 in looking at nothing in particular, P020 pretending that they can read an X-ray and actively fooling other members of group, killed patient quickly." [Observational data, pharmacy-nursing group]

"P020 still not listening to nurses despite killing the patient twice." [Observational data, pharmacy-nursing group]

Uni-professional outlook

On rare occasions participants expressed what could be termed uniprofessional opinions. These were somewhat warped views of the relative benefits or challenges their profession had to face.

"I guess we're [student doctors] just the Lone Rangers [laughter]….No one wants the medical students [laughter]." [D010]

Pharmacists in particular had negative opinions of the value other professions placed on IPE (Figure 4.31):

P012: I don’t know because personally I don’t think any other profession takes IPE as seriously as pharmacy students and I don’t even mean that in like a biased way.

P013: No, I agree with you, yeah.

P011: Because I think any work that we get given we take seriously.

Figure 4.31 Pharmacy students opinion of other professional groups engagement with IPE

4.6 Theme 5 – Stereotyping

Stereotyping was frequently observed amongst participants in this phase of the study, this phenomenon can be divided into two major areas: stereotypical behaviour and stereotypical education. Participants rarely acknowledged that they were behaving in a stereotypical manner, in fact there was often a dissonance between their verbal responses and their non-verbal behaviour. This possibly suggests a superficial level of agreement with the overarching aims of IPE. Participants also tended to articulate educational concepts in a manner which was stereotypical to their own profession, i.e. nurses often spoke of education as experience whereas pharmacists were more theoretical with their responses. These findings reflect traditional educational paradigms associated with nursing and undergraduate pharmacy.

4.6.1 Stereotypical Behaviour

Stereotypical behaviour was usually exhibited by single professions with specific traits for each professional group. However it was noted that all professional groups would behave in a stereotypical fashion if they had knowledge to share for the benefit of the patient. Examples of this included doctors interpreting X-rays despite being asked to play the role of the pharmacist, nurses taking control of oxygen prescriptions and pharmacists recommending potential antibiotics to prescribe.

D010: Guides N010 through the respiratory exam after she requests a CXR, then uses her medical specific knowledge to interpret the CXR

P030: Asks D010 about CXR

D010: Explains medical basis of crackles

Figure 4.32 Participants reverting to profession specific stereotypes in order to problem solve

Pharmacist stereotypes

Pharmacy students were observed to play to a number of stereotypes, the most frequently observed behaviour was the desire to look up answers, especially in the BNF (conforming to the stereotype of reluctance to make decisions).

"it'll be alright it's only oxygen" [P015] in response to a big debate amongst the four group members re oxygen, cue lots of furious looking in the BNF" [observational data of pharmacy only group]

Students appear to spending a long time agonising over decisions which don't really matter. *"I don't want to rush it"* [P012] [observational data of pharmacy only group]

"What other common antibiotics for a chest infection would you see with a penicillin allergic patient... even out in community? Even if you're being such a stereotypical pharmacist by looking in the BNF there [to P030]." [Researcher de-brief]

Pharmacy student behaviour such as this tended to be associated with a slow decision making process which has a detrimental effect on patient care. This necessitated explanation in the de-brief.

"It was interesting watching you [pharmacy only group] make decisions because you took a long time over everything and you were thinking about, 'Well what antibiotic can I give? What dose do I give? How do I give it?' this kind of thing and you were very methodical. Which is good and it's probably how you've been taught to be but if you had a guy who was dying in front of you it might not have been [laughs]." [Researcher de-brief]

Although students did justify their behaviour somewhat by expressing the limitations of their competency as well as their reliance on NICE guidance (Figure 4.33).

Res: Do you think it was fair to kind of you know just in this situation you were probably the leads for prescribing medication or for looking up what to give.

P022: Well we know where to look and where to start.

P026: Like were not doctors but we know where we'd find the information [yeah] to find it so like nice being there.

P021: It was like oh like yeah, we need to give like an anti-hypotensive and we're like okay let's look at NICE and BNF see what we would first use.

Figure 4.33 Students justifying their slow decision making process based on their levels of competency

Another stereotypical behaviour exhibited by pharmacy students was avoidance of conflict, or a fear of making mistakes. On more than one occasion pharmacy students ignored requests for help from other students (Figure 4.34).

D010: [to P030] "What would you recommend for *H.influenzae*?"

P010: [Does not respond for ten seconds] "not sure"

D010 struggles with a drug name, looks to P030 for help [P030 slightly ignores this request]

D010: [to P030] What drugs would you give him? If cephalosporins caused that, what would you give him? It's just interesting to know what we would do. [LONG PERIOD OF SILENCE]

Figure 4.34 Three examples of avoidant behaviour from the pharmacy student

Pharmacy students were also observed to misinterpret situations due to their reduced exposure to clinical practice.

"Let's wait for micro to come through before prescribing antibiotics." [P030] *Others inform P030 that the results are already back.* [Observational data]

Pharmacy students tended to lack confidence or be shy and retiring in unfamiliar situations. Participants acknowledged this with a stereotypical joke about their profession:

"I'm going to do this like a real pharmacist, not speaking to anyone" [P015]

Nursing Stereotypes

Nursing stereotypes were often interlinked with their training and previous experience where they described past events, or linked current events to past occurrences. One strong theme which emerged was the fact that nurses prioritise patients above everything else, especially sick patients.

"as nurses, we prioritise our workload of the patients that are more acutely unwell and do the things we need to do for them first before we start chasing other things for other people." [N010]

This prioritisation of the patient above everything else helped nurses to deal with conflict in multidisciplinary teams.

[in response to question re team working and personality clashes] "We're there for the patients at the end of the day and the treatment that we do is for the patient." [N010]

Another stereotypical trait of nurses was to rely on other members of the team in terms of technical knowledge even though their knowledge may have been superior in the situation. This was highlighted when a nurse made a prescribing recommendation for paracetamol, but still double-checked this with the doctor.

"Let's prescribe some paracetamol", best doing i/v?" [N010 to D010]

Nursing students framed their view of what should happen in the simulation based on previous experience, it was particularly noticeable that they had well defined limits of competence (particularly around diagnosis and prescribing) where they would defer to other healthcare professionals.

"When I've done it [simulation] with the medical students, they've diagnosed and then we've given the treatment as nurses." [N010]

"I think in terms of like deciding to prescribe it was like a collaborative thing but for me like I don't usually get involved in what drug to prescribe over another like that's not my decision. I sort of like left that to these guys [pharmacists] because as long as they're not allergic to it as far as I'm concerned if it's doing the right thing then I would just give it." [N006]

Some nurses had a fatalist attitude towards this particular facet of their interaction with the medical team, describing their lack of power in the situation.

"when you look at the bigger picture, you're just doing what you're told to do, technically. You [doctors] tell us what you want and we do it." [N010]

However nurses felt strongly that they were sometimes stereotyped as being less able members of the healthcare team.

"Yeah with and you know as a nurse with other healthcare professionals sometimes they don't respect that you know what you're talking about, that you've seen similar situations, that you've experienced it before and the phrase, 'You're just a nurse' has been said more times before so patience in that respect is necessary." [N006]

Again experience allowed nursing students to play a defined role with pharmacy students, deferring to their superior pharmacological knowledge where necessary. Nursing students also expressed concern regarding the medico-legal aspects of administering medication, they were patently aware of the consequences of administration errors, and very cautious when administering unfamiliar drugs. This suggests the nurses view themselves as the final barrier to drug-related errors.

"I suppose that's where our knowledge kind of falls down then and where the pharmacist's knowledge is more improved because you're aware of what's in certain medications. You then maybe highlight and say, 'Just be wary about giving this one due to the penicillin', whereas, I wouldn't know that. Obviously, if I'd have read the leaflet properly and gone through it, I'd have picked it up and then thought…maybe then we should look at giving him something else." [N010]

Medical Stereotypes

Stereotypical behaviour of medical students was cited both from within and without the profession. These behaviours tended to centre on personality traits such as hubris as well as the hierarchical nature of the profession. Observational data from the multidisciplinary group (where the doctor played the role of pharmacist, and the nurse played the role of the doctor) revealed some innate stereotypical leadership behaviour on behalf of the medical student (Figure 4.35).

D010 thinks about case like a doctor despite playing pharmacist role

…than D010 who is guiding the others through the process of diagnosis. D010 has certainly reverted to type. [observer]

N010: Takes over as doctor by using a bit of authoritative non-verbal behaviour (slight raising of voice) "Right, he needs a bit of oxygen."

Again N010 tries to lead like doctor but D010 intervenes due to medical specific knowledge regarding ABG results. [observer]

Figure 4.35 Examples of stereotypical authoritative behaviour from medical student

Medical students also had a tendency to abnegate responsibility for a situation if they felt they did not possess the requisite skills, this was very noticeable with respect to knowledge of pharmacology in the simulation

"I'm no good at drugs" [D010] then throws BNF in P030's direction. [observational data]

"*Gosh! I wish I was this good at pharmacy."* [D010]

Where medical students lacked knowledge they tended to be inquisitive of the other professions, trying to learn as much as possible from them.

"[to pharmacist] What drugs would you give him? If cephalosporins caused that, what would you give him? It's just interesting to know what we would do." [D010]

Medical students also acknowledged some generalisations around demanding behaviours amongst their own cohort, again this was linked to hierarchical relationships in the medical profession.

"Yeah, they do but I think a lot of them [medical students] haven't had jobs before. They've not worked and they've not been in the real world. They don't really understand. From their background, they think that everyone is below them. On the ward, they're like, 'We're the best. We want to follow a consultant or a surgeon.'" [D010]

Observational data showed other healthcare students behaving in a stereotypical manner if they were role playing the role of a doctor. This generally involved leadership behaviours or authoritarian interactions with other members of the team (Figure 4.36).

P012 tells P011 what to do (stereotypical doctor nurse relationship) N010 takes over as doctor by using a bit of authoritative non-verbal behaviour (slight raising of voice) "Right, he needs a bit of oxygen."

Figure 4.36 Other healthcare students modelling stereotypical medical behaviours

These stereotypical behaviours were augmented by stories regarding hubristic behaviour of medical students on experiential placements from all participants.

"…because when you're on your ward round and the doctors are demanding all these things from you (because they do, don't they?)..." [N010]

"in practise there's definitely people that are like, 'No this is the way' but I don't know whether I've been more experienced of that because I'm a learning disability nurse and like a lot of the time when I'm working in healthcare there is like a massive difference between like doctors and patients and you do have to sit down [laughs]." [N005]

Another finding was a noticeable dissonance between verbal and non-verbal responses from participants in the study. Participants tended to agree with the aims and concept of IPE verbally, but then revert to type non-verbally or when the scenario became fraught. The medical student in the multi-disciplinary group actively denied any stereotyping took place in their group as they all worked well as a team, however observational data shows a somewhat different story where the medical student reverted to type despite being asked to role play a pharmacist (Table 4.4).

Verbal Responses (in focus group)	Observational Data (from simulation)
Res: Anything else that's different to how you'd normally work with someone? D010: As in we're all three different...? P030: Yeah, I don't think there was any conflict. D010: Like stereotyping? I don't think we did that.	D010: "I'm no good at drugs" throws BNF in P030's direction. Again N010 tries to lead like doctor but D010 intervenes due to medical specific knowledge regarding ABG results.

Table 4.4 The dissonance between verbal and observational data collected from a participant

This suggests that participants may feel pressured to agree with the principles of IPE even though they don't value them in practice.

4.6.2 Stereotypical Education

Participants often spoke of stereotypical educational experiences, these may have been past experiences or student paradigms of what they believe to be good educational opportunities. Stereotypical educational experiences were discussed by pharmacy and nursing students, medical students were more difficult to categorise due to their mixed (clinical and theoretical) education and thus have no input in this section.

Pharmacy students acknowledged their strengths in terms of pharmacology and the therapeutic uses of drugs. However this was tempered by the belief that their knowledge was theoretical and they did not possess experiential knowledge which would allow them to realise how long medicines take to work in a patient and how their condition would improve.

"Ours [education] is just like theories isn't it? Ours is like a theory or like [yeah] you just follow a certain procedure like we don't actually know what happens from that." [P026]

"I mean when the patient comes in we don't really know what to do we just know like what drugs they're on and what drugs to give." [P023]

Pharmacy students believed their lack of experience hindered them in this respect, compared to the requirement for pre-registration nurses to complete 2300 clinical (experiential or simulation) hours prior to qualification, pharmacy students have varying levels of exposure which would usually amount to less than 100 hours.

"I think the problem is that we don't get much hands on like you [nurses] get placements all year, all through the year we get you know one school placement three times a year do you know what I mean? [yeah] and you know we don't get that hands-on approach to be like, 'Oh actually I've seen this' and it would be good to get that." [P026]

Pharmacy students also cited the nature of their placement activity as being a hindrance to working effectively in the scenario, as they often saw patients in the recovery phase and commented upon previous prescribing rather than being present at the decision itself (mirroring medical students in phase 1).

"when we go on placements, we look at patients who have already been prescribed certain things. We just go through and see why they did this." [P030]

Pharmacy students did believe that the simulation was positive step towards involving them in greater patient care, and that with practise they would increase in confidence and competence.

"I think the confidence comes with like the experience as well because this was like our first time doing this [yeah] so, obviously initially like me I was just a lot like is there anything else we could be doing? Are we doing our own thing? But obviously if you do it a few more times you'd be like, 'Okay' [yeah] lets do this, do that."

Nursing students were vocal advocates of experiential learning citing that this was both the best way to learn and a strength of their profession.

"…they [other professionals] don't respect that you know what you're talking about, that you've seen similar situations, that you've experienced it before" [N006]

Conversely nursing students did acknowledge the limitations of their experiential education, citing that differing experiences on placement resulted in different skill sets for students.

"…we all got different placements so we know different things so, like I was saying once I've stabilised then I've got no idea what to do because from an A&E perspective I save lives and then they went to a ward to be treated…but I'm sure some of you have been on medical wards a lot more than I have so could deal with a long term effect but maybe not the immediate." [N004]

Nursing students were more comfortable with a stereotypical relationship or role such as triaging the patient and then acting on their thoughts, as they had first-hand experience of the situation.

"I suppose that's about your level of knowledge, isn't it? When I go in and do observations, I'd ask questions and I'd get a background on a patient and then the doctor decides what

treatment they're going to give. As a nurse, if I was doing that sort of thing [prescribing] on my own, I wouldn't feel comfortable because I wouldn't really know what to give." [N010]

The findings surrounding stereotypical education were summarised by the researcher in a de-brief following the simulation:

"…nurses have a lot of grounded knowledge so, you've seen things before and you're confident in dealing with them whereas pharmacy students is a whole, you know what to prescribe but you don't know what happens if you know what I mean?" [Researcher de-brief]

4.6.3 Echoes of Stereotyping in Phase 1 Data

Following on from the discovery of overt stereotyping in phase 2 of the study, the raw data from phase 1 of the study was re-analysed and coded looking for overt or subliminal signs of stereotypical behaviour. A small number of instances were found possibly due to the researchers not actively looking for stereotypical behaviour at that stage of the study.

Stereotypical Behaviour

The most frequently observed stereotypical behaviour in phase 1 data was participants taking stereotypical job roles, this was despite some participants being highly specialised and experienced practitioners in the area. This was noted in student participants by the independent observer:

"…..in each group there was a clear role for each profession. The nurse consistently focused on obs, pharmacists on drugs, and doctors on the physical examination and had overall knowledge of the situation." [Independent observer]

Students did not tend to follow these roles in a hubristic or protectionist manner, rather they used them to educate each other surrounding aspects of patient care (Figure 4.37).

N002	Suggests taking obs.
D001&D003	Examine X-ray and consult each other on assessing it, then explaining to the group what it shows.
P002	Suggests/prescribes a drug.
P002	Politely disagrees with D001 and D003 based upon his pharmacy expertise and gives specific advice.

Figure 4.37 Student participants taking stereotypical roles and responsibilities

Lecturer participants valued having a wider mix of expertise in the room, and again specifically relied on another professionals superior knowledge.

"And I think also it's good to have a mix, like I said to you, I'm not sure about dose and I turned to my pharmacist here "what is it??"" [NL01]

More experienced professionals also realised that they may have behaved in a stereotypical manner which may not accurately reflect how they work in practice.

"I think we've been quite stereotypical, haven't we? We'd got a whole sea of things that we could go in and look at and we homed in straight on the respiratory and I don't think a nurse would necessarily go straight to respiratory, or a medic." [PY02]

Following on from stereotypical job roles participants also used stereotypical knowledge bases to assess the patient. Nursing students were very keen to touch and observe the patient and the technology limited this somewhat.

"I think if you could see what the patient is doing or breathing, you can tell a lot from how the patient is positioned in bed." [N002]

Pharmacy students lived up to their stereotype of being reluctant to make decisions without further advice, however they were very happy to provide advice on the best choice of treatment once that decision had been made, probably reflecting a paradigm interaction taught on the MPharm (Figure 4.38).

D003 [Directed to P002] 'Want to give him steroids?'

P002 'It's up to you'. Makes doctor make the decision, but P002 can provide advice on which steroid to prescribe.

Figure 4.38 Pharmacy students being reluctant to make a decision

Participants were also honest when it came to assessing their competency of "non-core" skills, this appeared to be a mechanism to complement others as well as method of delegating responsibility.

P003: Yeah, there were certainly parts that I'd have had no idea about, like X-rays or to be able to do mechanical ventilation. If you showed me an X-ray, I wouldn't know what to look for.

D001: Sort of likewise on drugs.

Figure 4.39 Participants honestly assessing their competency

There was only one occasion of an actively negative stereotype being portrayed, and this was by a physiotherapy lecturer possibly reflecting previous or historic experience of the pharmacy profession.

"or the pharmacists come down with their green pen and write all over the prescription chart."

[PY02]

Stereotypical Education

The stereotypical educational experiences referred to in part 1 of the study explored different concepts to those forwarded in part 2. This probably reflects the differing demographic (lecturer vs student) in the two phases of study.

Lecturer participants noted that students would stereotypically be pushed to one side if there was an acute emergency on placement, citing simulation as a way of circumventing this problem.

"Because they're not a priority. Whereas in here, you can see what happens in an anaphylaxis like what we saw, and how quickly, and what you could be doing, and I think that's just invaluable really, for their learning." [NL01]

"That's a good point actually because, you're more patient focussed than student focussed when you're doing something like that." [PL01]

Lecturers also painted a somewhat stereotypical picture of their students describing them as frightened of making mistakes:

"It's that sometimes students are shall I say frightened, frightened to make a mistake or frightened to make an error, even in the class, i.e. not wanting to say the wrong thing in front of their peers, and things like that. [general agreement]" [PL01]

Student participants also gave some examples of stereotypical experience when asked to name a difference between the virtual patient and real patients:

"That patient behaves themselves [Laughter] or is not a dementia patient on a full moon. But in placement, I've seen patients that have gone from happy people to absolutely scared and self-harming and you just cannot predict that." [N001]

In general, although stereotypes have often been cited as behaviours to avoid in previous IPE studies, most of the time they were used in a positive way to improve teamwork, delegate responsibility and ultimately improve patient care.

4.7 Key Findings

- Participant involvement with the simulation was facilitated by high acuity problems, an increase in risk taking behaviour was reported when compared to real patients.
- Despite being briefed that the simulation would respond in real-time students expected an immediate response from the VP to any interventions made.
- Nursing students struggled to care for the VP when compared to medical and pharmacy students. Primarily this was due to being unable to physically touch the patient and limitations on multitasking.
- The practical nature of simulated technology allows nursing students to clearly articulate the breadth of their knowledge.
- Immediate feedback provided by the VP allows students to reflect-in-action and modify their responses as they see fit.
- When a single participant was uncomfortable with making a decision, a shared decision making process was modelled. This increased participant confidence in the decision.
- Rather than actively disagreeing with each other, students tended to ‘steer’ less experienced team members to a more appropriate response.
- Role-reversal made students behave in an uneasy manner during the simulation, as they were not familiar with the role. On reflection students valued this experience as a way of experiencing and understanding the pressures facing other members of the healthcare team.
- Decision making processes consisted of pragmatic patient focused methods and theoretically focused, guideline driven ideas.
- Pharmacy students were particularly prone to worrying about the minutiae of a case to the detriment of patient care.

- Deference was observed amongst pharmacy and nursing students. When medical students were unaware of what to do, they often abnegated responsibility to other professional groups.
- There was often a dissonance between verbal responses in focus groups and the behaviour observed in the simulation itself.
- Participants felt most at ease when adopting stereotypical professional roles, this often aided communication and teamwork in the simulation.
- Pharmacy students demonstrated a strong desire to look up answers in the BNF, nursing students characterised themselves as the patient advocate, medical students often exhibited leadership behaviour.

Chapter 5 – Educational Findings

5.1 Introduction

Healthcare simulation was defined by Scalese in 2008 as "A person, device or set of conditions which attempts to present the evaluation of problems authentically, readily available at any time, and can reproduce a wide variety of clinical conditions" (105). It is an effective mechanism for bridging the gap between knowing that and knowing how (101,102) i.e. for converting theoretical into practical knowledge.

Simulation in healthcare was adapted from pedagogies developed in the aircraft industry where high-functioning teams are essential for passenger and crew safety (168). Air travel has clearly defined start and endpoints with a successful outcome being the safe delivery of passengers and/or cargo to the intended destination. Medical care may be more nebulous with poorly defined start and end points; however certain aspects of medical care share the aircraft industries' start and end points: namely surgery and acute care. The vast majority of healthcare simulations focus on acute and emergency settings; possibly due to the obvious similarities with the aircraft industry. Reeves and Van Schaik noted in 2012 that acute simulations may not be educationally beneficial in more routine sub-acute settings such as a ward or primary care environment (62).

This study takes simulation beyond the environment of the emergency room/operating theatre into the sub-acute setting. This inherently increases inclusivity as healthcare professionals who would not normally work in acute environments such as pharmacists, physiotherapists, occupational therapists and speech and language therapists are able to take part in a scenario. The results demonstrate sub-acute, real-time simulation as a valid and useful pedagogical method in the education of pre-registration healthcare professionals.

However they also show some of the pitfalls associated with it such as hyper-observation of a patient, and stereotypical projections of one's own profession.

The educational outcomes of the sub-acute simulation modelled those reported in the literature. Students were allowed total control of decisions and could see the consequences of such in a patient-safe environment. Increased engagement was reported in comparison to more traditional paper-based case studies, and immediate feedback allowed students to reflect-in-action and modify their responses as necessary. As predicted by Reeves and van Schaik in 2012 a sub-acute scenario produced results which have not been seen in previous literature (62). Participants expected the VP to respond immediately to interventions, when this did not occur it resulted in hyper-observation of the VP to the detriment of patient care. Participant involvement in the simulation was increased during high-acuity situations. I suggest that these findings may be due to previous experience with acute high fidelity simulation.

This chapter details participant responses to technology including its' perceived benefits and limitations with reference to previous literature in the area. In addition to this, educational outcomes of the simulation are detailed paying particular reference to the CAIPE definition of IPE "where two or more professions come together to learn with, from and about each other.(169)" Other observed educational phenomena such as competency frameworks, the ability of the simulation to facilitate reflexive practice are explored in the context of current literature.

Two novel models are proposed to explain why undergraduate student groups responded to the simulation in different ways; and finally the ability of the simulation to facilitate interprofessional education is explored with reference to the effect of the 'Hidden Curriculum' on participants (207).

5.2 Technology

All participants demonstrated engagement with the technology used to deliver the simulation. Student participants were largely millennials and as such demonstrated a natural affinity with the technology adapting their skill set where required, and demonstrating coping mechanisms with software malfunctions (208).

Important aspects of the technology were cited as the visual nature of the VP, verbal responses, and immediate feedback provided to learners. This increased engagement and reported enjoyment of the learning activity.

Participants acknowledged the novel challenges provided by the simulation. Students demonstrated emotional engagement with the virtual patient, with advocacy, concern, fear and anger all being expressed in response to the simulation. There is no dissonance between our work and previous studies on simulation which demonstrate students empathising with virtual patients (115,209), and that virtual patients improve student empathy with standardised patients (210). It may be argued therefore, that augmented reality (AR) induces empathy amongst participants in a similar manner to virtual reality and computer or web-generated simulations. Johnsen and colleagues (211) argued that undergraduate healthcare students demonstrated increased levels of empathy to a life-size virtual patient as opposed to a less than life size variant. Students in our study still showed empathy and concern despite the 'patient' being a less than life size representation in AR.

This technology was viewed favourably and recognised as a realistic and valuable teaching tool by all the qualified healthcare professionals who took part in the study. Physiotherapy lecturers were included in the study to elicit their opinions on how the simulation could be expanded to include their students. Rather than simply intimating where the physiotherapy specific learning objectives could be added to the technology, they believed their students could take part based on the current design of the simulation. This ability to transcend its intended audience validates the simulation as a realistic learning experience.

Lecturer participants recounted previous experiences with similar technology involving SimMan® where students had been casual rather than professional in their interactions with a virtual patient. These fears were not borne out in the experimental phase of this study where students demonstrated professional behaviour whilst caring for their VP.

The avatar was positively viewed by participants as a facet of the technology which gave them a focus for their work. Pharmacy students especially appreciated this aspect of the simulation with the technology 'increasing their focus on the patient'. Smith *et al* (2015) defined pharmacists by their use of a 'therapeutic focus' when looking after patients. Pharmacists were shown to concentrate on drug aspects of treatment sometimes to the detriment of holistic care of the patient (212). Undergraduate pharmacy students in the UK have relatively short exposure to experiential learning when compared to their colleagues in medicine and nursing, thus they will have less exposure to patients and their viewpoints. The technology may help pharmacy students to go beyond the boundaries of their previous experience and develop new models of patient care. This is because it increases their patient focus, and challenges their previously held knowledge about drug use in patients. Wackerhausen would regard this as second-order reflection one of the key indicators of successful IPE (86).

Augmented reality (AR) was viewed less positively than the avatar and VP. The visual representation of the patient was regarded as important by participants as it provided a focus, but the composite image provided by AR was considered unnecessary, distracting and difficult to engage with on a technical level. As the AR avatar was generated via an iPad, it forced participants to look in the same direction at the patient (as opposed to each other). Participants stated this detracted from communication and effective collaboration within teams, although this effect was not noted by the observer.

Nurses, nursing students and physiotherapists suggested the realism of the scenario could be improved. Nursing students particularly related their experience to previous simulations they had undertaken with SimMan® technology. Negative opinions were associated with practical skills which a nurse or physiotherapist would consider routine daily tasks. Examples included not being able to physically manipulate the patient (e.g prop them up with more pillows to mechanically relive the breathlessness associated with COPD), and the inability to do more than one thing at a time due to the user interface (e.g. look at the patient whilst also looking at their observation chart) (see Figure 2.4 for information on the interface).

Nursing students and physiotherapists struggled to transfer their particular set of skills to an unfamiliar situation because they were not familiar with the set-up of the monitoring systems in the simulation. These participants had all the skills necessary to deal with the scenario, but the unfamiliar layout of blood test reports or the inability to do more than one thing at a time led them to feel they were not as efficient as they would usually be. This may reflect the more practical approach to learning favoured in nursing and physiotherapy schools when compared to pharmacy and medicine (212).

The technology facilitated IPE by enabling students to learn with and from each other. Individual specific knowledge gaps were filled in by other team members from nursing, medicine or pharmacy. All students valued the learning experience, with some actively re-visiting the scenario to attempt to create a more positive outcome for their patient. Students were happy with the level of communication and teamwork the app facilitated within their groups. Lecturers were positive regarding the potential for the technology to become fully mobile with benefits such as independent learning, reduced administration and the ability for students to undertake simulation from home the perceived benefits. Students were more cautious regarding this, highlighting that important non-verbal aspects of communication would be lost using asynchronous messaging services. It was thought this could result in serious misconceptions being carried forward which would result in poorer outcomes for patient care. Students also expressed concern about others' engagement with the simulation if they were not 'policed' by each other in a face to face formal setting. Students may be demonstrating their lack of real-world experience in these situations as often communication is necessarily asynchronous in the ward environment. In hospital, pharmacists, doctors and other allied health professionals often have multiple patients in different wards under their care. In primary care this is accentuated by patients living in diverse locations. This means face to face communication with all members of the healthcare team is not feasible, due to disparate locations. Studies have found that although the majority of communication in the ward environment is synchronous it provides for a disruptive workflow, reducing efficiency and increasing the chance of untoward events (213). The development of technology in this direction will require further investigation and piloting to discover if this student concern is valid, this should particularly focus on how effective communication may be mediated asynchronously.

The real time aspect of the simulation provides a novel pedagogical challenge for students. Previous simulations (75,95,214) are often undertaken in 'simulated time' as opposed to real time. In simulated time interactions take place more quickly in order to demonstrate an educational concept within a limited timeframe. This simulation allowed students to 'control' time in the way they desired; giving them the ability to pause, speed up or jump forward one hour in time. Despite this control over time, students reported feeling panicked, pressurised and forced into making decisions. The responsiveness of the VP created a time pressured situation which required a quick response. The simulation actually became hyper-real as opposed to real due to the technology giving students too much data to digest. Temperature and SpO_2 were displayed to 2 decimal places (Figure 2.4) which resulted in minor changes being observed in real time, creating a situation where students and lecturers alike hyper-observed the patient in real time for minute changes in vital sign readings. This increased concentration and engagement amongst students with expressions such as *'You're glued to it'* being used. Thus participants managed a sub-acute scenario in the same manner as they would an acute simulation, despite this not being an efficient use of time and resource. This may reflect the fact no participant had ever managed a sub-acute simulation before.

Simulation naturally suits itself to learners who would be categorised as activist/pragmatists by Honey and Mumford (163). Participants reinforced this point by actively acknowledging that the simulation drew out information which they would be unable to articulate in a classroom setting.

The open prescribing interface in the technology made participants choose the drug, route and dosing schedule rather than simply state *'I would prescribe an ACE inhibitor'.* This forced students from other disciplines to rely on pharmacy students, and also forced pharmacy participants into making clear decisions, which they did not enjoy. Despite disliking this at the time, all participants stated this would be educationally beneficial and useful for their future practise. This suggests the simulation may be useful for overcoming pharmacists traits such as lack of self-confidence (165) and avoidance of decision making (75,215–217).

In focus groups, it was of note that participants commented more on suggested improvements rather than the actual benefits of the current programme. One stream of suggested improvements involved the authenticity of the VP response. It was made clear that students (especially nurses and doctors) wished to interact more freely with the VP than via structured multiple choice questions. These concerns correlate with previous work which noted VPs lack social presence when compared to human respondents. If VPs are to be integrated more seamlessly into undergraduate education more research needs to be undertaken into the social context and non-verbal communication of avatars (218).

Real-time virtual patient simulation was well received by participants in the study, it has the potential to be useful aide to lecturers and undergraduate students. Participants compared the technology to previous experience with SimMan®, advantages include the ability to transfer the VP to participants' own devices thus reducing hardware costs associated with simulation suites. One SimMan® mannequin cost £78000 in 2013 (219); in addition to this maintenance, set up fees, technical support staff and associated room costs must be included in any final costings. Additional extras such as intravenous cannulation 'training arms' all have tangible economic costs. Our app cost in the region of £10000 to develop; however there are no associated hardware or technical support costs beyond this. If further cases were developed this may take three months of work from clinicians and technical staff costing approximately £8000 per case. As a result real-time virtual patient simulation appears to be a competitive, cost-effective educational intervention.

5.3 Education

5.3.1 Observed Educational Outcomes of the Simulation

During focus groups participants articulated eleven explicit skills, behaviours and knowledge sets they believed they had learned from the simulation and virtual patient (Table 5.1). In addition they commented on how the technology may fit into undergraduate and postgraduate curricula, the benefits of simulation, the way in which the intervention fostered independent learning and facets of the technology which they particularly appreciated.

Skills, behaviours and knowledge bases explicitly taught by the technology
Time management (including prioritisation)
Practical application of theory
Responsibility for patient care
Creation of, and testing of new treatment pathways
Critical thinking
Collaborative decision making
Real-time disease management
Independent learning
Confidence
A middle ground between pharmacist theory and nursing pragmatism
Reflection in action

Table 5.1 Explicit teaching points cited by participants

Participants in the study stated many benefits of this simulation in comparison to non-experiential learning activities. The most commonly cited benefit was the 'practical application of theory', which reinforces Kuhn, Polanyi and Scalese's ideas regarding the fundamental difference between 'knowing that' and 'knowing how'(101,102,105). Issenberg and colleagues expand on this and state key advantages of simulation as repeated practise leading to skill acquisition and maintenance (111). Thus it appears that AR simulation does not negatively impact on the transfer of knowledge base from a classroom to a practical setting.

Engagement was facilitated by the visual nature of the application combined with the real time feedback and responsiveness of the virtual patient:

"..we noticed was his [the avatar's] lips were going blue, so we definitely gave him oxygen." [D003]

This encouraged critical thinking in response to visual, audio and written data produced by the technology. Participants enjoyed the unpredictability of the patient journey in the simulation, and stated this as an advantage over traditional case study or problem based learning classes.

"…I think it's definitely more engaging than..the paper form people can just sort of switch off and just be like yeah whatever. Whereas with this because it's there and it's like an interactive type thing…it's definitely more engaging." [P025]

This attests to the decision made by the research team to develop the virtual patient according to a 'peripheral complexity' model (Figure 2.3) rather than as a linear storyboard, which results in a wider variety of potential outcomes for the VP. Immediate feedback provided by the application such as a reduction or increase in heart rate in response to drug administration allowed students to learn the consequences of their actions quickly and if necessary to reflect in action on their behaviours and re-evaluate their decisions. Thus the technology could be described as a method of fostering *reflexive* practise amongst students, something Schön referred to as the key to professional artistry (220). This will be discussed further in chapter 5.3.4.

Simulation offers advantages over traditional experiential learning activities due to its' reproducibility (221). Experience in healthcare situations is naturally transient and dependent on the availability of patients and acute situations to students (104). Whilst on placement students will be allocated tasks to complete but these will always be conducted under a modicum of supervision, with ultimate responsibility always falling to the qualified professional. Therefore, in real life students never have to accept liability for patient care, and the emotional burden associated with this. In addition, there will be natural variance in experience between members of a cohort. Differences in patient presentation, supervision style and quality, and interpersonal and interprofessional relationships developed whilst on placement all contribute to learning and the formation of a novice professional (104). In comparison with experiential learning, simulation allows an entire cohort to take full responsibility for a simulated (or standardised) patient. Each student is exposed to the same events, but derives their own experience based on their input and the patient response. This achieves the goal of student-focused learning based on educational need, as opposed to serendipitous learning based on patient availability in an experiential real-world setting.

Educational benefits were wider ranging than originally envisaged. Rather than simply facilitating patient and disease management amongst a multidisciplinary team, the intervention implicitly taught students a number of soft skills and professional behaviours necessary for individual as well as collaborative practice (see Table 5.1).

Participants particularly enjoyed the ability to test and create new treatment pathways. Students articulated their thoughts about the standard treatment for a COPD patient and then formulated a regime based on patient feedback such as vital signs after discussion with colleagues. If necessary students came up with novel (to themselves) treatments based on the response of the virtual patient. The open nature of the prescribing interface facilitated this, forcing students to choose a drug and dose from within a drug class based on incomplete information.

"When we were prescribing the drugs, it's almost like testing yourself in this situation. What can I give? You have to actually type it in and because it's so open, you have to go from scratch to filling it all in, don't you?" [D002]

Consequentially once students had developed a new plan for the virtual patient they took an active role in monitoring the response to treatment. In some cases this facilitated reflection in action, a key component of objective medical practice where students re-evaluated their plan where necessary and changed key components of treatment based on response.

A key advantage of this simulation compared to others is the mobile nature of the delivery mechanism allows greater flexibility in the delivery of any educational intervention. This could be used to allow students to learn in their own homes, libraries or other non-traditional settings at a time convenient to the student (133). Students were somewhat reluctant to commit to this style of education when directly questioned on the matter, citing issues with the authenticity of non-visual communication and student commitment to non-synchronous communication.

When formulating new ideas in response to unexpected feedback from the programme; students acknowledged they had to go beyond the constraints of NICE guidance whilst at the same time felling 'nervy'. Heidegger (99) and Gadamer (100) theorised that useful experience only occurs when preconceptions are not confirmed by an event. Only when a situation refines, elaborates or disconfirms prior knowledge is an event *experience.* Students appear to have been challenged by the simulation and forced to elaborate on, or disregard previous paradigms of information, making this clearly a useful learning experience according to the above criteria.

Students agreed that the real-time nature of the VP (as opposed to a paper-based case or real patient) allowed them to actively experiment with treatment plans. The scenario forced students to make a decision quickly and observe the consequences of that decision. They explicitly enjoyed the challenge provided by the real-time nature of our simulation, reflecting results in a similar study conducted by Söderström *et al* (222). In Söderström's study, immediate feedback prevented a conventional discussion based decision making process from taking place as students relied on each other's tacit knowledge in order to problem solve quickly. In turn this encouraged active experimentation to a greater degree than conventional paper-based methods of learning (222). In our study immediate feedback (via vital signs changes), encouraged students to reflect-in-action. It was however observed that in some cases revisions were inappropriate, made too hastily and resulted in patient harm. This suggests that despite the scenario occurring in a sub-acute setting, students are still responding to the scenario in an acute manner, with poor consequences for patient care.

The death of a patient proved to be a paradigm learning experience for some student groups defined by Benner as *"a clinical episode that alters one's way of understanding future clinical situations"* (97). Paradigm cases elicited both emotional and educational responses from participants. Educationally paradigm experiences increase student awareness of their limitations and thus facilitate a shift from what Kruger and Dunning would describe as 'unconsciously incompetent' to 'consciously incompetent' (223). Often if student groups made a critical error they reformulated their plans and attempted the scenario again. This gives students the opportunity for deliberate practise which in turn is associated with positive outcomes from clinical simulation (107,111). Deliberate practise increases student familiarity with future similar situations, is a valid method for learning from paradigm experience and is likely to improve student competence.

Simulations are often used to facilitate the learning of soft skills (62,75,108), in this case unintentionally the real-time (as opposed to simulated time) nature of the programme allowed students to reflect on their time management skills, in terms of how to prioritise patient care. The real-time updates and immersive fidelity of the simulation increased what participants referred to as 'pressure', and helped to suspend reality and replace it with simulation.

The pressure of limited time had a number of effects on participants. Students who learned how to deal with important issues first and prioritise effectively tended to have more successful outcomes for the VP. However this was negated when groups with effective prioritisation were impatient with response to treatment. Students and lecturers alike expected an immediate response when prescribing for the VP due to it being "a computer programme". This occurred despite participants being briefed on the real-time nature of the programme and having the ability to control time (e.g pausing the scenario). This impatience led many student groups to hyper-observe the virtual patient. As students had none of the distractions of normal life on the ward (relatives, other patients, telephone calls etc.) they chose to use their time observing the patient almost every minute. Participants believed this increased the pressure of the situation as they saw a real-time deterioration in minutes when in practice they may only observe a patient every 10-15 minutes.

In the de-brief students acknowledged this limitation, however the pressure to act on information improved student critical thinking skills. A rapidly deteriorating VP required speed of thought and clear action; when this was the case students inherently focussed on their desired outcome for the patient. In turn, this facilitated collaborative working as participants relied explicitly on information from other professionals as this was the quickest and most efficient way of treating their patient. The lecturer group and student groups both relied on the expertise of their colleagues in this manner; reinforcing the suggestion that this is both a professional and useful model of multidisciplinary working.

To avoid the phenomenon of hyper-observation in future simulations further thought could be given to design of the scenario. Giving students one patient alone naturally leads to hyper-observation as students have no other focus. Student focus could be expanded by offering other challenges within the simulation itself. At a simple level this may involve having to update relatives, a focus on the actual administration of medication, or telephone calls which disturb student concentration but form a large part of the working day of any qualified healthcare professional. Another simple solution would be to design more VP's for students to look after. This could follow the model of interprofessional training wards reported by Pelling *et al* (79), with a small interprofessional team caring for six patients.

A key educational feature of the technology was the ability for students to take full responsibility for the care of their 'patient' with no recourse to supervisors. Responsibility is a key character trait for healthcare professionals, and the fact they were given total care of the patient was appreciated as something which would be impossible to replicate in a real life situation. Interprofessional ward environments managed by undergraduate students, the closest model to real-life work revealed by the literature review, still have some degree of oversight from qualified staff (81). By contrast in the simulation students took responsibility for their own learning alongside the care of the VP. A serendipitous observation revealed students replaying the simulation in their own time following a poor outcome. This demonstrates students using the simulation as an opportunity for repeated practise and mastery learning for a non-technical skill. McGaghie and colleagues clearly articulate the need for simulation to achieve this in their 2010 review of simulation in medical education (107).

Participants also acknowledged the value of simulation for improving student confidence. Confidence to deal with the VP in the simulation was inherently linked to increased levels of prior exposure to experiential learning or simulation. This was reflected in leadership behaviours displayed by medical and nursing students during the simulation. Pharmacy students were the least confident in the scenario and were observed to be less likely to take the lead than nursing or medical students due to their decreased exposure to experiential learning.

Students actively seek frequent confidence boosting and reassurance from the facilitator.
[Observational data of pharmacy-only group]

5.3.2 Participants' Postulated uses in Education

Participants foresaw using the app in various ways in different settings. Students thought it would be useful prior to specific experiential learning opportunities. This prior exposure was postulated as a mechanism of providing students with tacit knowledge which could then be applied in a real-world setting. In short the app, increases student confidence with real cases, which in future would allow students to integrate more effectively in a multi-disciplinary team as they would be able to speak the language of healthcare professionals.

Students also thought the technology would provide benefit if used as a revision aid, due to the powerful nature of the experience. In addition to deliberate practise within the classroom setting, students advocated the use of the simulation via mobile media, as a revision tool:

P012: But like I think it was good that we did do this like almost a year ago now because…

P011: It [revisiting a therapeutic area] refreshes you

P013: You know that some stuff sticks.

Students believed the technology could be used to allow students the opportunity to actively manage a situation which they had observed in previous placements. This would allow students to experiment with knowledge or practises they have observed, and apply and adjust them in a patient-safe environment.

The ability to practise and formulate new treatment plans in a safe environment for both patients and students, was cited as a benefit in comparison to more traditional high-fidelity simulation such as Sim Man®. The mobile nature of the app designed to deliver the simulation would mean students could use the scenario on their mobile phone or tablet devices. This suggests our simulation has benefits beyond traditional simulation due to its' portability. Soft skills such as prescribing and decision making could be both practised and mastered whilst students were on the move. Cochrane and Sharples define mlearning by the ability to learn on the move, and state that it will often facilitate andragogy and heutagogy amongst students (133,143). Our simulation cannot be said to be heutagogical or even andragogical in nature, as the research team designed the scenario to match intended learning objectives within each course. However, students were observed to show andragogical principles when they engaged with the simulation without supervision.

Lecturers were positive the simulation could be adapted for use in a uni-professional or interprofessional environment. The increasing complexity and multi-professional nature of healthcare led them to believe simulation has to involve more than one profession in order to be authentic. Lecturer participants thought the simulation encouraged key skills such as critical thinking, decision making and team working alongside the disease specific learning outcomes. Lecturers were particularly excited with the possibility of delivering the simulation to students own devices. The ability to monitor students remotely, and the encouragement of clear documentation which would be facilitated by asynchronous communication were thought to be key learning outcomes which could be facilitated by the technology.

Lecturer participants thought the theoretical model and real-time nature of the simulation increased the scope of clinical scenarios possible beyond conventional high-fidelity healthcare simulations. The real-time nature allows simulations to be delivered over a period of days or weeks as opposed to hours. This naturally lends itself to sub-acute scenarios but also into the field of mental health.

"I just think very often we concentrate on the physiological conditions and we forget about the psychological, and the psychiatric areas." [NL01]

Mental health patients may present with an acute crisis but practitioners are often reliant on medicines which will take weeks or months to manifest their full effect. This may preclude students from following a full patient journey during experiential learning, and does not lend itself to conventional simulation. The inherently theoretical nature of the application also marries well with the 'conceptual discourse' employed by psychologists and psychiatrists in their routine interactions with patients (212). In the conceptual discourse a psychologist typically identifies and solves patient problems with psychological theory. This approach requires an extended period of time to take effect. As a result real-time virtual patient simulation may provide students with a unique opportunity to take full responsibility for a VP with a mental health issue over an extended period of time.

5.3.3 Competency

Simulation is often used as a way of allowing students to apply knowledge in a 'safe' (or neutral) practical setting, another way of viewing this is it allows students to test their competency. Our simulation captured what Kruger and Dunning would describe as unconsciously incompetent (223) students via observed behaviour within the simulation, and by computer generated feedback. The unconsciously incompetent student is the individual defined by Kruger and Dunning as possessing the least ability of all (Figure 5.1). An unconsciously incompetent individual is one *'who grossly overestimates their own ability'* and is unaware of their own limitations but still possesses the minimum amount of knowledge necessary to engage with a task (223).

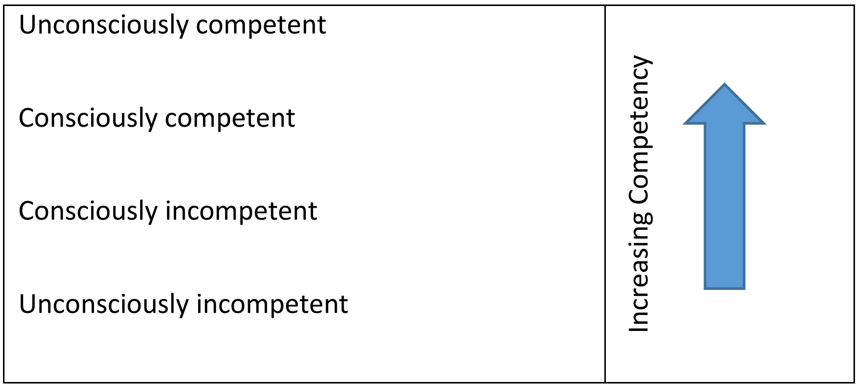


Figure 5.1 Kruger and Dunning's stages of competence

In a healthcare situation the unconsciously incompetent provider is the most dangerous for patient care as they may continue to manage a situation beyond their competency without asking for help. The paucity of data surrounding students and trainees at this level of incompetency poses a question for healthcare training providers, how do we as educators de-brief these students? But also, how do we catch these students before we allow them to practise in the real world?

Our simulation was intentionally designed to provide challenge by testing the key skills of each professional group: for nursing students this was believed to be observation of clinical findings, for medical students' diagnostics and the formulation of treatment plans and for pharmacy students' commentary on prescribing and drug therapeutics. Thus, as educators we were aware that some students did not possess the tacit knowledge necessary to interact with all parts of the scenario or to interpret all the information given in the simulation.

As some student groups did not have the full complement of professional staff (pharmacy and nursing students; or pharmacy students only). Attempts were made to compensate for the lack of expertise in the room. It was observed that this provoked incompetent behaviour from students, which was to be expected. Nursing and medical students were weak on pharmacological management, pharmacy and nursing students struggled to interpret X-rays, and medical and pharmacy students tended to struggle with the practical administration of oxygen.

An extreme example revealed one pharmacy student attempting to interpret X-rays, convincing other students he had the ability to do so. It was clear to the observer that this was not the case and during data analysis the result was labelled as subversive behaviour. This can equally be seen as a student demonstrating his unconscious incompetence, the student was clearly a danger to others, and he (and his group) managed to kill the VP three times via the same mechanism in a short space of time. This demonstrates a) the student continued to be unconsciously incompetent as he was not learning from mistakes b) other students in the group did not have the confidence or tacit knowledge to give negative feedback to this individual[1]. This case reiterated the following assertion of Kruger and Dunning: *"the Incompetent seldom improve in life as they rarely receive negative feedback. Even if they receive feedback which points to defective skills they may attribute this to another external factor"* (223).

When challenged on their behaviour in the de-brief the student acknowledged they *'did not like to be seen to not know an answer'*.

This suggests the ability of the simulation to reveal unconsciously incompetent students to educators before they are allowed to work in practice. The simulation captures the unconsciously incompetent as unlike in many other simulations there is no defined 'role' for them to play. The sub-acute nature of the scenario naturally lends itself to collaborative practice and what Reeves and van Schaik refer to as ad-hoc teams with poorly defined responsibilities (62). Students can choose to do anything, most used their perceived

[1] This group contained only pharmacists and nurses, a medical student may well have had the tacit knowledge and confidence to challenge this student.

competence to choose traditional roles with which they felt most confident (thus limiting their responsibility).

…As a nurse, if I was doing that sort of thing [prescribing] on my own, I wouldn't feel comfortable because I wouldn't really know what to give." [N010]

The unconsciously incompetent student took advantage of the lack of safeguards in order to take responsibility without the knowledge to deal with it.

Phrases such as *"don't give anyone with COPD 100% oxygen"* demonstrate that consciously incompetent students exposed to paradigm events such as death actively reflected and learned from the experience. Clearly unconsciously incompetent students did not learn from their experience.

Dunning and Kruger state that the only way to effectively de-brief unconsciously incompetent students is to make them competent, which then gives them the metacognitive skills necessary to realise their errors. The best method of debriefing an unconsciously incompetent student has not been defined in the literature, from our experience it is difficult to de-brief such a student in a group setting due to both time constraints but also to avoid embarrassment for the individual. Singling out students or other professionals for particular criticism has been regarded as undesirable within the simulation literature. Doctors have been found to fail to highlight perceived deficiencies in nurse behaviour due to teamworking and hierarchical dynamics: *"I am not going to be too critical…in the debriefing, because I still need to work with that person"* (62).

Negative feedback is critical to achieving competence amongst the incompetent (223), however it must be delivered in a manner which does not compromise the safe environment of the simulation. The de-brief of simulations is regarded as the most important and effective feature of this style of learning (107,224,225). Consciously competent or consciously incompetent students clearly learn the consequences of their actions from the simulation. Unconsciously incompetent students were identified by experienced facilitators and then de-briefed appropriately. If this technology is to become fully asynchronous attention needs to be paid to how these students are identified and made fully aware of their limitations before they are allowed to practise.

5.3.4 Reflection-in-action

Students were encouraged to reflect on their actions in the de-brief following the session and provided many insights into their thought processes and feelings regarding the simulation. Observational data from the simulation itself revealed students actively reflecting-in-action, responding to changes in feedback from the virtual patient almost immediately.

Student participants acknowledged they often felt uneasy when the virtual patient did not respond to drugs in the expected manner. This was most frequently cited when the VP temperature continued to increase despite adequate antibiotic therapy and administration of paracetamol. In response to this students often started to question their role in the scenario and whether there was anything more they could do for the patient. Pharmacy students turned to NICE guidance to help them with their suggestions whereas medical and nursing students relied on their tacit knowledge to think around the situation. This 'taking a step back' may be referred to as reflection-in-action or reflexivity, and is an essential skill for any healthcare professional.

Schön refers to reflection-in-action as reflecting on a behaviour in the moment it happens, in healthcare this involves problem setting as opposed to problem solving (220). It is described as the key to professional artistry and Schön argues that technical rationality alone fails to resolve the dilemma of rigour versus relevance. In other words, evidence base is important but it has to be ameliorated by the pragmatism of the situation faced by the practitioner. Schön's work builds on that of Dewey (1933) in *'How we think'* where he mentions the ‘reflective conversation with the situation.’ Stockhausen expanded upon Schön and Dewey’s thoughts applying them specifically to experienced nurses ‘through the experience of exposure to patients and situations a heuristic knowledge develops integrating practical experience and theoretical knowing’ (226). This is key to professional artistry in modern healthcare practice, the ability to integrate knowledge of the evidence-base behind a treatment and then apply and adapt it to an individual patient.

Stockhausen describes experienced nurses reflecting in action at a sub-conscious level, which they find difficult to articulate to students. She states that often students are rule-governed and fail to recognise to nuances of a situation in the same manner as an advanced practitioner, ratifying Benner’s previous work on the differences between novice and expert practitioners (97,226,227).

It is therefore educationally significant that students were observed to be reflecting-in-action during our simulation (Figure 3.12 and Figure 4.11). Reflection in action occurred in response to immediate feedback based on the vital signs of the patient, mirroring Söderström’s findings with dental students (222). Students in our simulation also recognised that more experienced practitioners may not follow rules as closely as themselves, confirming Stockhausen’s thoughts on the inherently difference between student and expert response to events:

Researcher: *you put him on the right therapy and his temperature carried on going up. How did that make you feel?*

P002: *Nervy.*

P003: *You question whether it was the right therapy and that’s why I was just constantly thinking that we weren’t on the right antibiotics or there was an interaction somewhere that was going on.*

D003: *Maybe we were doing it too by the book and maybe in practice, you’d do it... well, not by the book as much...*

Nursing and medical students vocally articulated tacit reflexivity more frequently than pharmacy students. For instance, if an alarm went off signifying a deterioration in vital signs, usually a nurse would be first to react by checking the observations and then reporting them to the medical student. Pharmacy student reflexivity was somewhat delayed in response to this, they would often search guidelines for further information, or try to theorise different potential treatments for the VP. This delayed reflexivity was often not articulated to other students in the simulation itself. It was only uncovered when pharmacy students described their thoughts and feelings surrounding the deterioration of the VP in focus groups (Figure 3.12). The limited exposure of undergraduate pharmacists to patients, acute situations and real-life working environments; in comparison to medical and nursing students may provide an explanation. As Schön and Stockhausen explain one must have pragmatic skills alongside theoretical knowledge in order to be reflexive (220,226). Studies on graduate pre-registration pharmacists (216) and qualified pharmacists (164,165,167) reveal a lack of adaptability alongside a reluctance to take responsibility for decisions. There is a paucity of data regarding reflexive practise amongst pharmacists, but reflexive practitioners will adapt to new situations with ease. In addition to their relative lack of experience it is possible student pharmacists are modelling poor reflexive behaviour they have seen in their qualified counterparts via the 'Hidden Curriculum' of Hafferty and Gilligan (207,228).

Hafferty originally defined the hidden curriculum in 1998 as a set of influences that function at the level of organisational structure and culture (228). Hafferty argues that that a great deal of what is taught and most of what is learned in undergraduate study takes place outside of formal course offerings. Wackerhausen expanded upon this concept in 2009 by arguing that professional identity is acquired tacitly in practice. In order to become a fully integrated member of a profession a person has to acquire and behave according to the cultural norms of the profession (86). Thus pharmacy students will model behaviours they have seen in qualified professionals in order to confirm to their perception of what a pharmacist should be.

The pharmacy profession in the UK has significantly changed since the 1980s. Ward-based clinical pharmacists became commonplace in the 1990s undertaking an advisory role at the point of (or closely following) prescribing. In parallel to this the traditional pharmacist role as the 'preparer and compounder of medicines' (Oxford English Dictionary) has both been simplified due to the reduction in extemporaneous dispensing activities and devolved to pharmacy technicians and assistants.

Rosenthal argues that the pharmacy profession's perception of professional artistry has not evolved beyond the compounding of medicines (164) which in turn has caused a crisis of confidence in the profession (167). This crisis of confidence could easily be passed onto students via the hidden curriculum. A lack of perceived artistry will directly relate to limited occurrences of reflection-in-action according to Stockhausen (226). If qualified pharmacists are not reflexive then it is unlikely that students will learn this concept.

In the simulation the strength of pharmacy students was their objectivity and their ability to detach themselves from the situation in order to provide medicines related advice to other students.

"I think you can like go back to pharmacology and pathophysiology so, do that first and then you would think about you know like NICE guidelines and everything because that's just kind of an algorithm." [P010, taken from Figure 4.21]

This correlates closely with the medicines advisory role which pharmacists have embraced as their core function since the 1980s. In traditional practice pharmacists are often detached from the immediate point of care and as such are valued as objective theorists. This often lends itself to being an advisor or even a conscience for a prescriber, reminding them of any risks relating to medical treatment which may have been overlooked in the pragmatic care of a patient. It has been argued that pharmacists have co-opted their role in the healthcare team as educators (229). It is likely that pharmacy students have both been taught this role explicitly but also via implicit role modelling of qualified colleagues.

This behaviour could be categorised as reflective as opposed to reflexive but I prefer to label it as delayed reflexivity. Due to their relative inexperience with patients, pharmacy students have less practical knowledge than their medical and nursing peers. In addition their lack of experiential learning means they have less experience of observing qualified pharmacists problem set and problem solve. This results in them being less adept at reflexive practice.

Stockhausen argues that experts are often unaware of what they know, and are often unable to articulate why they are doing what they are doing clearly to students. Her study revealed numerous examples of qualified nurses demonstrating reflection in action subconsciously in the presence of students. I suggest that the pharmacy students in the study have been exposed to education and clinical experience which has allowed them to become mildly reflexive in the field of medicines advice. In addition to this due to the paucity of data in the area, the pharmacy profession has not yet developed an appropriate language for what Stockhausen would describe as its' Métier artistry (226). She describes this as where the core skills of the professional are combined with unconscious intangible intuitive knowledge. Pharmacists display an inherent ability to both comment upon and advise regarding drug therapy and patient care, this is the art of pharmacy in the 21st century as opposed to the preparing and compounding of medicines.

5.3.5 Educational Paradigms

Feedback from focus groups revealed fundamental differences in the way student participants perceived education. Nursing students relied heavily on experience to articulate their learning, constantly using patient vignettes or using phrases such as *I saw, or I have seen*. Nursing students also struggled to divorce their knowledge from patient presentations with one commenting:

"…if somebody said to me, 'What you know about anaphylaxis?' I would freeze, and I'd be like, 'Well I know nothing about anaphylaxis' but if I saw the signs of anaphylaxis on a patient I'd be able to tell you…that was what it was, and this is how we treat it, and this is what we do." [N010]

Pharmacists were much more accustomed to theoretical classroom based learning experiences, citing this as a disadvantage whilst dealing with the VP.

"I think the problem is that we don't get much hands on like you [nurses] get placements all year, all through the year we get you know one school placement three times a year" [P026]

Medical students were comfortable with both theoretical and practical learning styles. It was refreshing to note that the technology was viewed as a way for all participants to share knowledge and meet in the middle of their respective educational models.

"I think the software was kind of like a nice halfway house between like the front line training that nurses have like [P026] was saying and the very much theory-based knowledge that pharmacists have it was like a nice place for us both to meet and to be able to execute decisions." [P020]

These perceptions of education appeared to influence how students behaved during the simulation and how they responded to changes in VP presentation. I have named these perceptions the 'educational paradigms' of professional education, the default or most common educational practice used within a body of professional education. It appears that early 21st Century pharmacy students are at the opposite end of an educational continuum in comparison to nursing students (Figure 5.2). Pharmacy students receive a strong theoretical training punctuated by short periods of experiential learning. Nursing students on the other hand have a highly experiential learning experience punctuated by 'theory blocks'. These paradigms are not rigid, may well overlap and provide some explanation as how students perceived the educational experience.

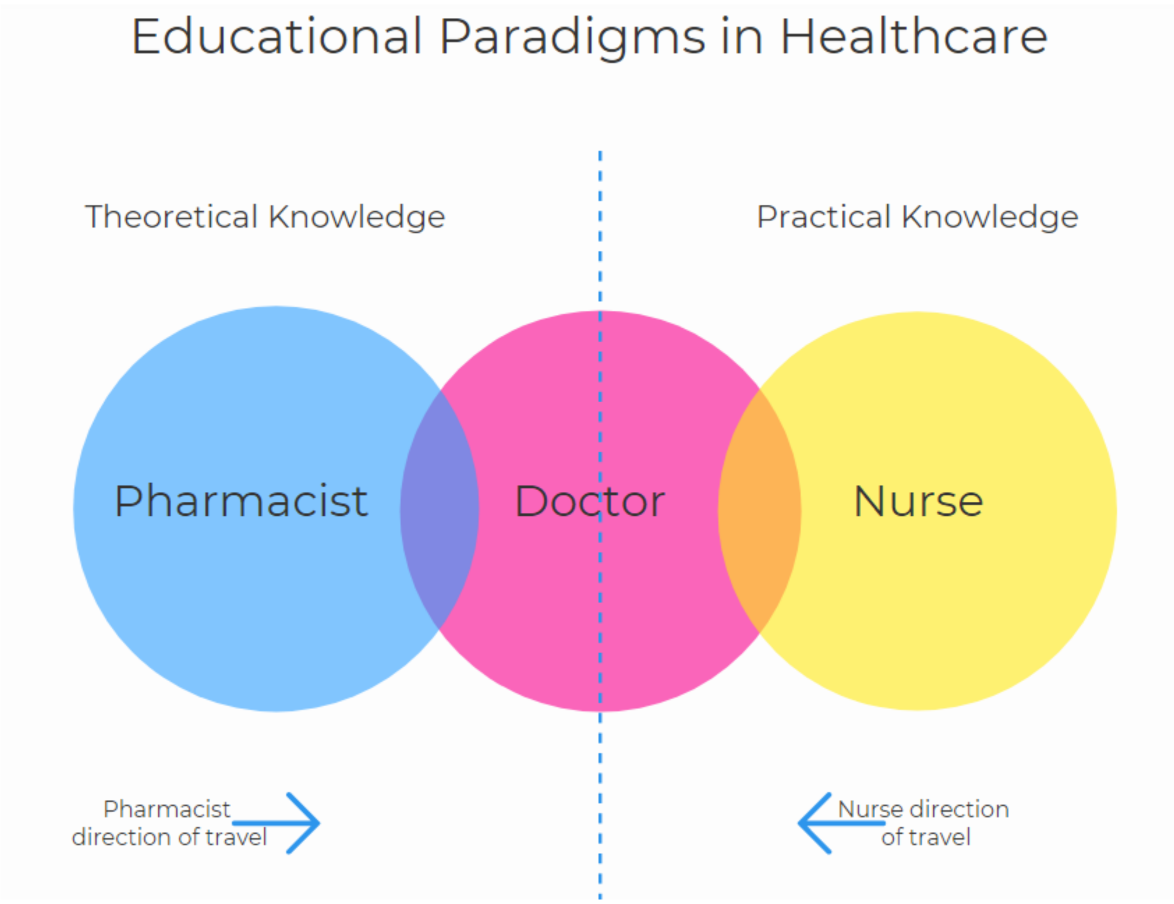


Figure 5.2 Traditional education paradigms in healthcare and their direction of travel

The simulation was designed with the intention for each profession to have an area of responsibility, *something to do*. Despite this, a decision was taken to allow students to interact with the simulation in whichever way they chose. Prescribing responsibilities would not be limited solely to doctors, observations could be undertaken by any professional and again blood tests could be ordered by all participants. Despite the freedom afforded to them, students quickly adapted their roles to areas where they felt comfortable. These 'comfort zones' appear to be explicitly related to the educational paradigms (Figure 5.2), students may have been taught to take responsibility in these areas either explicitly or implicitly.

The theoretical educational base of pharmacy students meant they often found it difficult to deal with the unknowns of patient presentation; especially during critical events such as tachycardia or hypotension. In layman's terms they knew what drug to give at what dose but then didn't know how a patient should respond to the treatment. Both student pharmacists and lecturers relied on their BNF as a 'comfort blanket' or a 'coat' to turn to in the face of any question, emphasising their need to remain in touch with concrete evidence to apply to the scenario. Pharmacy students would sometimes control the iPad, but would rely on other members of the multidisciplinary team to lead the diagnosis of the patient; students related this behaviour to their lack of experiential learning. Pharmacy student knowledge was centred on drug action and therapeutics. They possessed good knowledge of appropriate prescribing practises corresponding to what Smith and colleagues (212) referred to as a pharmacists 'therapeutic discourse' when dealing with patient problems.

Rosenthal and colleagues (164) noted that pharmacists often sought approval from other healthcare professionals. The primary endpoints of pharmacy practice studies often rely on the work of other practitioners (i.e number of prescriptions changed as a result of an intervention); as opposed to a marker of actual patient benefit (e.g. reduction in blood pressure, patient satisfaction). They postulated that pharmacists are actually more concerned about other healthcare professionals' view of them rather than patient outcomes. This study demonstrates pharmacy students struggle to follow through monitoring plans for patients, suggesting they are unfamiliar with formulating primary patient endpoints for their work and they actively rely on other more experienced practitioners to monitor patient response to treatment.

Nursing students performed strongly with respect to the initial stabilisation of the VP (providing oxygen therapy) and the continuous monitoring of the VP vital signs. Beyond these areas nursing students started to articulate discomfort. The inherently practical experience to which they had been previously exposed allowed them to respond appropriately to VP deterioration by increasing the frequency of observation. Often they waited for medical students to formulate a treatment plan, but would advocate a different pathway if they deemed the decision unsuitable (cf Figure 3.6).

"..his obs may come down with that, what else can we give him?" [N002]

Medical students often took the role of leader of the healthcare team, explaining the physiological mechanisms behind what was occurring to the VP, leading on initial diagnosis and explaining the medical basis for any treatment plan proposed. Other students were observed to defer decision making to medical students, forcing them to take ultimate responsibility for prescribing (Figure 3.8).

'Want to give him steroids?' [D003]

'It's up to you'. [P002]

As medical students have a strong grounding in empirical scientific understanding alongside exposure to the natural variation of patient presentation, this places them in a natural position to lead a team of undergraduate nurses and pharmacists. Austin *et al* (2007) provide an alternative explanation, they note that doctors are trained to put on the 'cloak of competence', to be confident in their decisions even if they do not know the outcome (166). Burford and Rosenthal-Scott list confidence, trustworthiness and responsibility as positive stereotypes of doctors, these qualities naturally lend themselves to leaders (230). A combination of both educational paradigms and cultural appropriation is likely to create doctors as leaders of the healthcare team.

If medical students were not present in the simulation the overall responsibility was shared between nursing and pharmacy students. Nursing students tended to stabilise the patient and provide pragmatic solutions to pharmacy theory. Pharmacists took on a significant role in prescribing when medical students were unavailable, and were happy to do so in that situation. This reveals a power dynamic between medical and pharmacy students, which will be discussed further in the chapter on stereotypes. Nurses appreciated the pharmacy students' help with the more theoretical aspects of the simulation, as they often struggled because there was no actual patient (or mannequin) to touch and interact with.

Deferring responsibility to doctors has been reported as a phenomenon in the literature. Pojskic *et al* reported that doctors thought the fact that other professionals failed to take final responsibility for their patients was a significant barrier to collaborative working (231).

I argue that the educational paradigms respective to each undergraduate school influence and directly affect the way in which students interact with the simulation. Pharmacists fail to respond quickly to patient events due to their theoretical training; nurses struggle to articulate the theory behind their practise due to their experiential training. Recent developments in education advocated by the governing bodies of nursing and pharmacy appear to wish for their students to travel in different directions to the centre ground where a balance between practical and theoretical needs is met (72,73,232,233). This centre ground is clearly occupied by the medical profession at present with a structured 5 year degree consisting of a strong theoretical base followed by increasing levels of patient-facing clinical experience. Figure 5.2 explains the current educational paradigms and direction of travel. A migration of pharmacist and nurse education towards a combination of practical and theoretical knowledge may not improve patient care. One could argue that pharmacy and nursing are copying the medical model in an attempt to increase the prestige and social standing of their respective professions. As a counterpoint, successive governments have lobbied the allied healthcare professionals to accept increasing responsibility as an acknowledgement that doctors are both expensive and time consuming to train. One of the original arguments from the medical profession against non-medical prescribing was the assertion that this would provide ‘doctors on the cheap’ (49). Leaders in nursing and pharmacy need to ensure that when training prescribers they do not lose their original knowledge bases and maintain their professional differentiation.

5.3.6 Paradigms of Practice and their Influence on Education

The simulation placed no restrictions on an individuals’ practice, nurses were free to prescribe, pharmacists could undertake clinical examinations. It was observed even when a student was allocated a different role to their own, they often reverted to learned roles and behaviours. This reveals that not only education has a bearing on how students interact with a VP, they also approach patient care in different manners. Smith and colleagues refer to professional equipoise as a method of explaining how members of a profession care for a patient (212). Doctors and pharmacists tend to approach care in an objective mechanistic ‘find it, fix it’ manner; nurses are more likely to empathise and account for the personal beliefs of any patient under their care. One can argue the overriding approach to education and patient care provided in individual schools both in the written and hidden curricula may ‘pigeon hole’ students into areas and philosophies of practice. This overriding approach provides domains from which students and professionals can strike out from, or revert back to in times of stress (as is the case in our simulation). Using established norms from the literature, and findings from the study resulted in the map of professional domains shown below (Figure 5.3). This diagram plots the usual and comfortable education standpoints of each profession (from theoretical to pragmatic) against the way in which they care for patients (objective to humanistic). Low level or low achieving members of the profession will feel safe within these domains, whereas the high achieving members will strike out from these domains into other areas of practice.   The central tenets of collaboration must involve some understanding of these domains both within and without the professions.

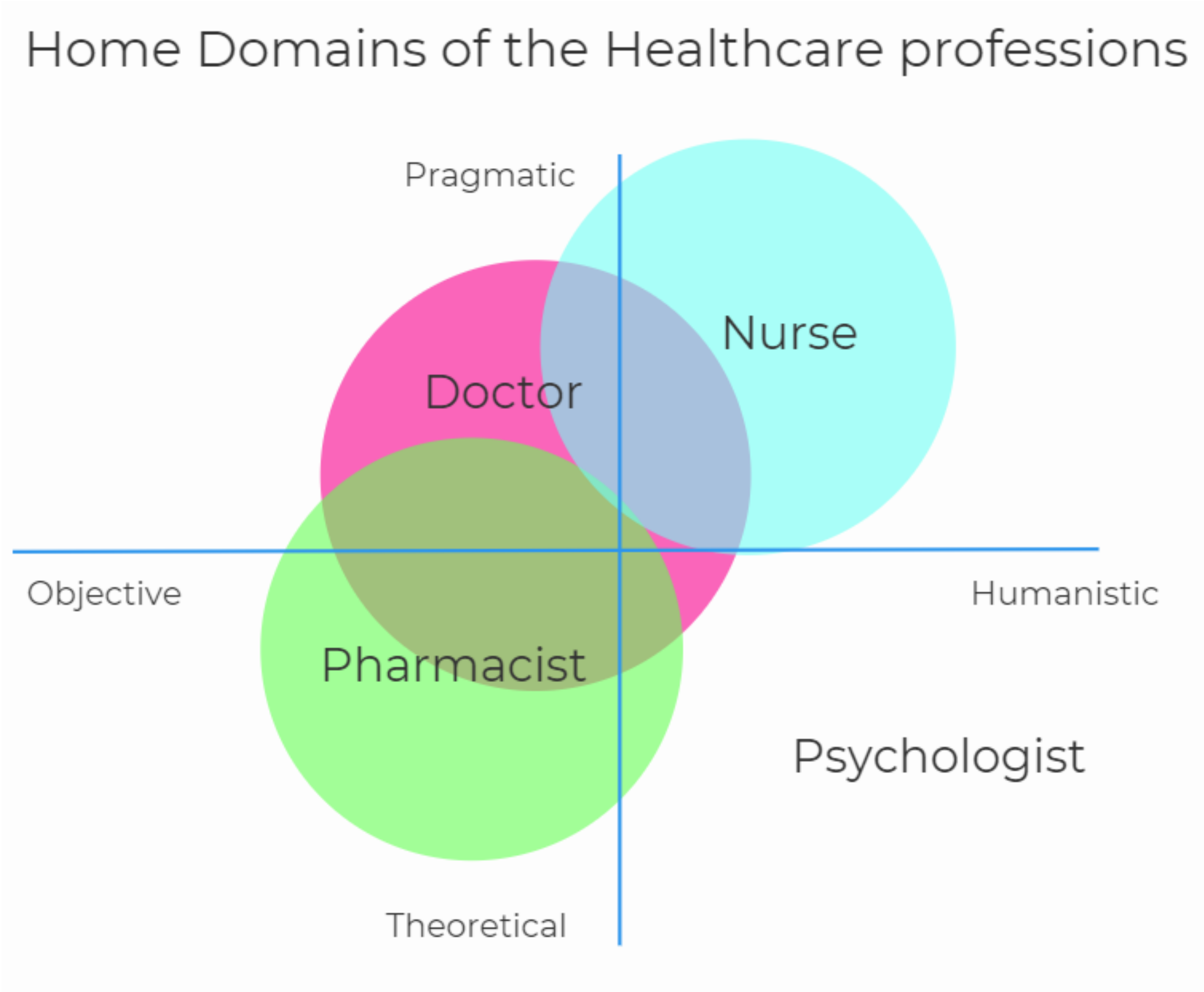


Figure 5.3 An explanation of the home domains of some healthcare professions with respect to a caring approach, and an educational approach

This model has explanatory rather than predictive power as there will always be wider variation within one profession rather than between professional groups. Advanced practice in any profession should focus on expansion of these domains rather than migration towards another. Much talk of advanced or expanded roles for pharmacists focuses on what they could do in GP practice, or in advanced specialist roles. This could be viewed as migration from a traditional dispensing role towards an advanced GP-like role, which would cause the pharmacist to lose some of their theoretical knowledge base. Pharmacists who later qualified as doctors refer to this as breaking the rules of pharmacy based on a pragmatic approach to patient care (166).   One could argue that these domains may limit student horizons by placing student firmly within one domain of epistemology with respect to education and patient care. The difficulty with migration from these domains is that it may result in a dilution of the skill mix and broad range of experience necessary to care holistically for a patient.

Although the educational domains (Figure 5.3) provide some explanation for how multi-disciplinary healthcare teams may care for a patient, they also may limit student horizons. If nurses are only trained in a humanistic and pragmatic manner then there is the risk of them blindly following rules. It may be argued that theoretical knowledge allows an individual to develop creative solutions for problems. The natural manner for a nurse to achieve this is via reflection-in-action which relies more on problem setting than problem solving. Another argument which the model sheds light upon the medical role as leader in the healthcare team, as the objective pragmatic practitioner (with a reasonable amount of theoretical knowledge thrown in) they may be seen as the most creative of the professions as they marry their theoretical background to the pragmatic difficulties of treating the patient in front of them. Doctors 'push the boundaries' of medicine by developing new treatments or procedures to trial on patients; they are defined like many other high-ranking professions by their autonomy (168,234). One could argue this very fact relegates other healthcare professionals to a subservient role as they have not been trained or do not have the power to effectively integrate all the domains of knowledge necessary to develop such a procedure. Any new treatment plan inherently bears risks and benefits to a patient. Pharmacists and nurses may in fact act as a barrier to new treatments, as their job is to highlight the risks of pharmacological treatment or advocate the patient perspective in a humanistic manner to the doctor. As such pharmacists and nurses could potentially be viewed as killjoys or hindrances by doctors by placing necessary barriers or other perspectives in the way of a new treatment plan. This may be one of the key steps in the breakdown of interprofessional collaboration in healthcare.

5.3.7 Facilitation of Interprofessional Education

Participants advocated the technology as an excellent method for facilitating interprofessional education. Effective healthcare in the 21st Century requires a interprofessional team approach in order to facilitate the best outcome for a patient (65,168,174,235). Thus, in order to recreate best practice clinical simulation naturally requires a degree of collaboration. Students believed meeting other professional groups in person maximised this learning opportunity. If it was not possible to gather busy professional students together at a convenient time, asynchronous messaging was regarded as a reasonable solution for communication between professional groups.

As the intervention was designed to facilitate IPE, I have compared the learning outcomes cited by participants to the well-established CAIPE definition of IPE "*When two or more professions come together to learn with, from and about each other*" (169).

Each of the eleven educational outcomes associated with the simulation (Table 5.1) have been mapped to the CAIPE definition. Outcomes were allocated to more than one theme if it was thought to be applicable in both cases. The results of this are seen in Table 5.2:

With	From	About
Time management (including prioritisation)	Creation of, and testing of new treatment pathways	A middle ground between pharmacist theory and nursing pragmatism
Practical application of theory	Collaborative decision making	
Creation of, and testing of new treatment pathways	Real-time disease management	
Collaborative decision making	Reflection in action (if verbally articulated to others)	

Table 5.2 Explicit educational outcomes in relation to the established CAIPE definition of IPE

Seven reported educational outcomes could be framed within the established definition of IPE. The clear way students learned from each other in the simulation was when students shared subject specific or personal knowledge, allowing for real-time disease management. Only one reported learning outcome focused on 'learning about' other professional groups (finding the middle educational ground between nursing and pharmacy). This frames the question that whilst this simulation makes students learn with and from each other, how effective is it as an interprofessional education intervention if it only briefly touches on learning about each other? This question will be discussed further in chapter 6.4 on stereotypes.

Four skills were found not to relate to the domains of the IPE definition: responsibility, independent learning, confidence, and critical thinking. These are useful skills for any professional, and could be viewed as personal development milestones for fledgling professionals. Rather than directly relating to the aims of IPE, these are skills which are useful for forming high-functioning teams and could lead other professionals to form favourable opinions of an individual.

If there is no explicit way of teaching students about each other in an IPE intervention then it is likely they will learn about each other using the hidden curriculum. In order to become a fully integrated member of a profession a person has to acquire and behave according to the cultural norms of the profession (86). Gilligan *et al* (2014) define the hidden curriculum as lessons which are learned without being explicitly intended (207). They argue that if students observe poor interprofessional practice in the workplace or if placement supervisors fail to provide or recognise IPE opportunities then students will learn that IPE is of little value in daily practice. During development of their own IPE programme, Tassone and colleagues recognised that IPE is extremely vulnerable to the 'hidden curriculum' (236). To counter this they spent significant resource developing practice educators who both modelled and agreed with the overarching aims of the IPE (168).

In IPE if formal learning and teaching about other professions is absent; students may form stereotypes of another professional group (an out-group) based on the personality of one or two members of that profession. Despite the positive reviews of this simulation it relies heavily on participants portraying positive characteristics during the simulation and de-brief in order for individuals to leave with genuinely positive opinions of the other professions.

In addition to the above it was observed that a change in the mix of professional groups participating in the simulation had behavioural consequences. Nursing and pharmacy students asked to role-play the doctor adopted hubristic and paternalistic attitudes towards other participants. Focus group questions also revealed defensive and protectionist attitudes from students surrounding the simulation.

"I don't know because personally I don't think any other profession takes IPE as seriously as pharmacy students and I don't even mean that in like a biased way." [P012]

Whilst all participants strongly advocated the need for good communication and teamwork between healthcare practitioners, it was interesting to see that they did not always model these behaviours during the simulation. One medical student participant was particularly critical of her own colleagues and their lack of engagement with other healthcare professionals. Despite this during the simulation the student threw a BNF at a pharmacy student asking if she could look up a drug. This behaviour suggests students are articulating an external agreement with IPE despite having some internal reservations or 'learned resistance' to the process. Perhaps IPE is a perceived as a politically correct form of education which students feel they cannot criticise. Schwartz noted that whilst individuals may go on along with team decisions it is still possible to disagree on an epistemological level (237). Collaboration easily occurs on paper, however it is much harder to change people's hearts and minds.

5.4 Summary

Participant feedback was largely positive in response to both the technology and simulation. Positive aspects of the technology included the VP generating empathy amongst participants, and causing pharmacy students place a greater emphasis on patient focused care. The interface itself forced students into making explicit decisions, which at the time students did not enjoy; although in focus groups students acknowledged the importance of learning in this manner. The technology facilitated IPE by generating conversations between participants which facilitated learning with and from each other. Poorly received aspects of the technology included the use of AR which added little to the simulation and may have detracted from good communication. Nursing students expressed a preference for physical representations of patients above a virtual patient as this would provide opportunity for multitasking and physical interaction in the simulation. A key advantage cited by lecturer was the ability of this technology to be used flexibly in different environments.

Educational findings were facilitated by various aspects of the simulation; the real-time updates in patient condition allowed students to reflect-in-action, suggesting that students were integrating practical and theoretical knowledge. Participants actively relied on each others' areas of expertise, and seven observed educational outcomes mapped to the CAIPE definition of IPE. The simulation revealed students operating a various levels of competency as defined by Kruger and Dunning (223). Unconsciously incompetent students were identified in the study, suggesting the simulation may be a useful assessment tool. This suggests the simulation may identify students who require remedial action to be taken prior to qualification. Finally the way in which participants are educated both in classroom and in experiential learning settings affects how students deal with the problems posed by the simulation. Nursing students take a pragmatic humanistic approach to patient care; pharmacy students an objective theoretical approach and medical students a more objective pragmatic approach. These complimentary approaches allowed for holistic care of the VP to take place. Educational drivers advocated by the regulatory bodies of the pharmacy and nursing professions may cause the initial training of nurses and pharmacists to more closely model that of the medical profession. This is not necessarily a positive finding, as diversity of opinion may contribute to greater distributed cognition and more effective models of care.

The paradigms of education and practice referred to in this chapter alongside the educational findings provide a starting point for exploring why participants behaved in the manner they did in the simulation. Real-time sub-acute interprofessional clinical simulation appears to be an effective method for the delivery of IPE. Deeper analysis and discussion of participant behaviour will shed further light on the team dynamics encountered in the study. These findings may provide further question for research and further suggestions for the future design of IPE simulations in the professions of nursing, pharmacy and medicine.

CHAPTER 6 – BEHAVIOURAL FINDINGS

6.1 Introduction

Interprofessional education is postulated to improve collaboration between professions in the workplace, however very few studies reveal modification of attitudes and even fewer behavioural change in the workplace. A criticism of research into IPE is that it is at the centre of an epistemological struggle between positivist and post-positivist paradigms. The majority of research into IPE has been undertaken researchers familiar with the positivist paradigm. As a result studies of the efficacy of IPE have been conducted in a similar manner to randomised controlled trials looking for quantifiable results from any intervention (90). RIPLS the most commonly cited questionnaire used to evaluate IPE has no basis for use as a pre-test/post-test tool and the original authors admitted that it could not measure attitudes of learners (238). There has been little reflection as to whether positivist studies are the best method of evaluating IPE. The qualitative, observational nature of our study allowed us to understand the mechanisms of interprofessional socialisation, and how students form interprofessional relationships.

It is clear that students must have a good understanding of their own professional role prior to an IPE experience. If they do not possess the knowledge then the ability of others to learn about them is severely diluted. Conversely the opportunity to interact with other professionals should confirm an individual within their role in the wider multidisciplinary team. Hallin and Kiessling stated "The ability to communicate and collaborate with other professionals gives students 'a mirror' to see themselves with. Then they become more aware of the role of their profession as they see its' importance to the team" (81). Clarity in relation to IPE means defining a clear role for your profession in a sociocultural context. Learning with each other is easily mediated by giving students an active experience where they must communicate with each other. Learning from each other may be addressed in the later years of healthcare courses where students possess profession specific knowledge which may be shared with others. Perhaps the most often overlooked aspect of IPE is the learning about each other, often studies have specifically targeted this aspect of the CAIPE definition by setting a task such as 'find out what a physiotherapist does'. Whether or not a task like this is set, students still learn about each other and themselves. They observe each others' behaviour, use of language and non-verbal communication to form an ad-hoc team, in other words they learn from a hidden curriculum set by their own behaviour. Gilligan (207) quotes Meizrow whilst writing about the hidden curriculum, his key component of adult learning is 'becoming aware of the cultural and psychological assumptions which influence the way we see ourselves and our relationships.'

Extra paragraph explicitly related to my findings re behaviours

This chapter details the collaborative practises and intrinsic behaviours displayed by participants in the study. These include collective and collaborative approaches to decision making, especially when there was no participant with tacit knowledge of the entire situation. Decision making processes fell into two main categories: pragmatic patient focused methods and theoretical guideline driven ideas. Participants would often fall into familiar job roles for their profession, often reverting to type if they were assigned to another role. This facilitated a highly effective team environment where participants actively relied on each others' expertise. Students did not like to be seen to disagree with each other in the simulation; if a student was thought to be displaying ineffective behaviour colleagues would 'steer' the student back to the problem at hand. Leadership behaviours such as bravery were modelled by all professional groups, and effective teamwork was facilitated by leaders. Profession specific behaviours were demonstrated with deference noted amongst nursing and pharmacy students and abnegation of responsibility amongst medical students. Dissonance was noted between verbal responses in focus groups and behaviour observed in the simulation itself.

Previously I have related how participants have been positive regarding interprofessional education and how the simulation forced them to collaborate effectively for the benefit of the VP. This opinion will be examined more closely with reference to literature regarding the formation of highly effective teams, behavioural psychology and observational data from the study. I introduce concepts such as Berne's model of transactional analysis as a method of investigating communication in IPE. Also Lambert's thoughts on politeness are discussed as an explanation of why professional groups behave in a different ways when confronted with similar problems. Behaviours core to effective team building such as leadership and followership traits are discussed with reference to psychological and ethnographic studies in the aviation industry and medicine. The 'hidden curriculum' introduced in chapter 5 once again appears to play a role with students often modelling 'learned behaviours' or stereotypical roles during the simulation. Finally there is acknowledgement that students may have hidden their true feelings regarding IPE due to the socio-cultural pressure to conform in focus groups and the simulation.

6.2 Collaboration

6.2.1 Teamwork and Communication

WHO describes interprofessional education as a technique to increase the likelihood of developing a collaborative practice-ready workforce (174). It is clear that any successful interprofessional education intervention must induce collaboration amongst participants. Collaborative behaviour was demonstrated from observational data, and reported by participants in focus groups. This was sub-divided into generic skills for collaboration such as teamwork and communication, and specific behavioural characteristics relating to good collaboration such as professional debate, and reliance on others' expertise. Many teams in healthcare especially interprofessional ones, are formed on an ad-hoc basis, working together for a short period of time then dissipating again into their wider uniprofessional collectives. In these terms the composition of the groups in our study was authentic, students volunteered from disparate courses, having little knowledge of each other prior to the simulation, and all going their own separate ways following the study.

All participants actively contributed to patient care using their professional background as the basis for their behaviour in the simulation.

Each member fell into their role, for example P001 took control of prescribing drug and dosage, N001 focused on taking physical observations, and D001 consistently provided explanations behind the changes in observations and the medical basis for the actions they were taking.
[Independent observer]

During the simulation participants actively collaborated in many ways, such as aiding each other with refining the problem, asking questions of each other, sharing knowledge and working towards the shared aim of patient survival. Examples include medical students being warned against prescribing penicillin (to an allergic VP) by nursing students (cf Figure 4.14). In focus groups participants were unanimous in thinking the technology facilitated communication and collaboration between themselves as people, rather than simply interacting with the technology as individuals. When pressed, individuals identified some key characteristics of high-functioning teams such as strong leadership, a balance of skills, as well as clear and effective communication.

"I think it highlights the fact that you need to work as a team, which is good. And it might pick out gaps in your understanding…that's why I'd need such and such a body to come in and help. It makes you more aware." [D003]

Participants perceived the need for a mixture of professions to interact with the simulation. When it was suggested that the simulation could be used for teaching solitary professional groups, students suggested this would require simplification of the task and detract from the educational experience.

"I do prefer it with different disciplines though, if it was the same [professional groups] it would lose something." [N002]

Participants strongly advocated the mix of professional groups due to their reliance on each other during the simulation; with both expert lecturer and novice student groups relying on each others' expertise at differing points in the scenario. Students shared knowledge clearly demonstrating they were both teaching and learning from each other. This resulted in a collaborative, shared decision making process; especially when participants were unsure of the way forward due to gaps in their personal knowledge .

"…I feel like we constantly like bounced ideas off each other and we…always referred to each other where we knew that where our, where the knowledge of our discipline ended someone else's began." [P020]

In a similar manner to Kruger and Dunning's findings regarding unconsciously incompetent individuals requiring a modicum of knowledge prior to believing in their own expertise (223), participants in our study appeared to be much more collaborative when they were unsure of themselves. If an individual team member was confident then collaborative decision making tended to suffer as other team members acquiesced to the superior knowledge and confidence of the individual.

"Right, he needs a bit of oxygen." [N010 takes over as doctor by using a bit of authoritative non-verbal behaviour (slight raising of voice)]

Conversely if team members bore no knowledge of an area often there was an over-confidence or lack of ability to communicate the need for collaboration.

P020 pretending that they can read an X-ray and actively fooling other members of group, killed patient quickly." [Observational data, pharmacy-nursing group]

Knowledge was not the only factor related to collaboration, a nursing student response provides an excellent example of perceived competency, possibly reinforced by or learned within the domains of learning (Figure 5.3) referred to previously influencing the individuals desire to both lead a situation and collaborate or seek help from other professionals:

"I think in terms of like deciding to prescribe it was like a collaborative thing. But for me…I don't usually get involved in what drug to prescribe over another,…that's not my decision so, I sort of left that to these guys [pharmacists] because as long as they're [the patient] not allergic to it [the drugs] as far as I'm concerned if it's doing the right thing then I would just give it." [N006]

This small comment demonstrates the nursing student perceiving his own competency level but also assuming the competency of other students (the pharmacists). The nurse almost delegates the task to the pharmacists as he does not feel competent to prescribe in this particular area; however he both protects himself and the patient by using a technique akin to safety-netting. He would check both the indication for the drug and any allergies prior to administration demonstrating his competency in this field. Perceived competency appears to be an important factor in the division of labour during the simulation.

Reeves *et al* (239) state effective teamwork requires a focus in 6 key areas: effective patient care, shared team identity, shared commitment, clear team roles, interdependence and integration between work practises. The nurse in the example above clearly demonstrates knowledge of these areas and has implemented them in the scenario. Gordon *et al* state that team building can only start with effective leadership. They argue there is a 'golden window' of leadership where leaders are neither autocratic nor laissez-faire (168). Leaders must establish their own competence, disavow perfection (in contrast to the hubristic student above reading X-rays) and encourage input from all in order to establish a highly effective team.

The findings from the study regarding an individual's propensity to collaborate may be represented by the 'bell shaped curve of collaboration' (Figure 6.1).

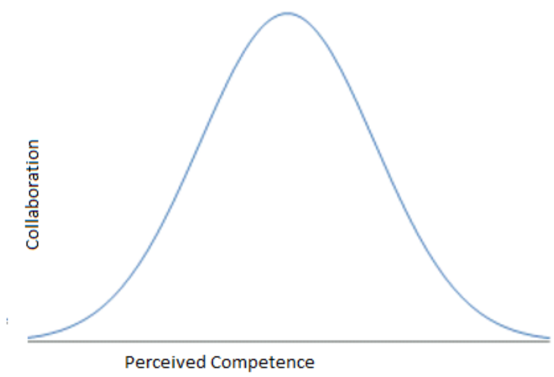


Figure 6.1 Effectiveness of collaboration plotted against perceived competence as derived from observational study data

These findings corroborate previous work by Kruger and Dunning (223), where the incompetent fail to recognise their need to collaborate. Gordon *et al* report that hierarchical structures common in western medicine often serve to maintain the status of the powerful.

As consultants are often referred to as *'Dr Surname'* this creates a power dynamic and possibly a barrier to effective communication. These so called toxic hierarchies reduce the likelihood of collaboration if people have no way of dealing with unequal power relationships (168). In common with our study if practising healthcare professionals are confident in their role and enjoy significant authority; they are less likely to see the need to collaborate, and more likely to delegate to others. This may in turn lead to hubris which is often associated with poor outcomes (1,4) and lapses in healthcare.

In addition to percieved competency and knowledge, one of the strongest predictors of good teamwork and collaboration in the simulation is the acuity of the situation to which participants are responding. Observational data from the study revealed students working much more effectively as a team following the trigger of a vital signs alarm:

"Particularly after the alarm had sounded all members became less polite and tentative; and more confident and forthcoming with their suggestions." [Independent observer]

Continuing on from these findings there is a natural tendency to work together within one's own competency when a situation demands it. For instance planned and emergency surgery in the early 21st Century NHS is characterised by teams with well-defined roles and competencies working together for a patient. The gravity of the situation ameliorates any desires to deviate from the common goal of a successful surgical outcome, and the lead surgeon will respect the work of other members of the team as essential to their practise. In other areas of health and social care a situation may be acute, but is not perceived as such due to factors such as incomplete information, competing interests of providers or poorly defined methods of communication between ad-hoc teams. Sub-acute scenarios often have poorly defined teams with overlapping or disparate areas of responsibility, these situations often suffer from professionals failing to take responsibility, or falling to realise they need to take responsibility in a given situation. If a situation is not perceived as acute individuals will often work side by side in comfortable silos. Examples of where this type of situation has ended with catastrophic consequences include the case of Victoria Climbé (1), Baby P (4,240) and the perinatal care provided in Morecambe Bay Hospital Trust over a number of years (241). Thus for good teamwork and communication necessary to facilitate collaborative practice to take place we propose three key pillars of an interprofessional simulation:

1) Participants must possess enough knowledge to understand their role in the scenario, but not enough to undertake the simulation on an individual basis (facilitating learning from each other)
2) Participants must be able to perceive the limitations of their own competency and have a rudimentary understanding of the competencies of other professional groups involved in the task (tacit knowledge of learning about each other)
3) Participants need to perceive the acuity of a situation in order to collaborate effectively as an interprofessional team.

When questioning participants about the important aspects of good communication, students in particular were adamant that face-to-face communication was essential for both interprofessional education in the undergraduate setting but also for effective collaboration in a real-world setting. The ability to speak to someone in person allowed participants to talk around a case and reason in a more collaborative manner than simply via telephone (lack of visual cues) or asynchronous messaging (loss of intonation, urgency). Students regarded asynchronous communication such as emails and text messaging in future simulations as particularly troublesome, as partners could develop misconceptions regarding the task in hand. It was thought this may lead to other professionals failing to recognise the gravity of a situation, or misdirecting their efforts towards unnecessary or inappropriate goals.

Despite these valid concerns asynchronous communication is often a necessary component of current healthcare practice. Consultant physicians and surgeons cannot be physically present in the ward environment at all times. Hospital pharmacies tend to operate with limited opening hours. Nurses are the profession closest to the patient, and they even are limited by the necessity of rest. In primary care practitioners such as GPs, community pharmacists and community nurses work in disparate and sometimes mobile locations meaning that face to face communication is extremely unlikely. Although students in our study favour synchronous communication, in the working environment it has been linked to increased rates of medical error. Edwards *et al* reported synchronous communication between doctors and nurses facilitated interruptions in the workplace, increased multitasking, and consequently increased the risk of error (213). Messages between individual healthcare professionals may therefore have to be delivered asynchronously. Strategies to reduce the risk of this form of communication are similar to those used with face to face communication such as the SBAR (situation, background, assessment, recommendation) tool (239,242,243). The aviation industry advocates the use of confirming questions such as "Don't you agree" in addition to the SBAR (168), however this strategy cannot be employed asynchronously.

Undergraduate IPE is often hampered by the conflicting timetables and locations of the professional groups involved. Real-time mobile simulation involving asynchronous communication offers a potential solution to scheduling conflicts. This technology may be a useful method to increase the opportunity for IPE in undergraduate programmes, however it must be augmented by training of practice educators to maximise experiential IPE opportunities and to reduce the likelihood of negative perceptions of IPE being passed to students via the hidden curriculum (207).

Few examples of actively poor communication were identified in the study. Communication certainly became more directed and focused when an acute situation developed, but prior to that most groups had a good collaborative atmosphere. Pharmacy students tended to be less forthcoming with suggestions especially in early stages of the simulation. In some cases they also displayed behaviours which were detrimental to good collaboration and practice. Pharmacy students were observed to react negatively to direct questioning from other professional groups if they did not anticipate the question (Figure 6.2).

D010: [to P010] "What would you recommend for *H.influenzae*?" P010: [Does not respond for some time] "not sure" *D010 then struggles with a drug name, looks to P010 for help [P010 slightly ignores this request]*
D010: What drugs would you give him? If cephalosporins caused that, what would you give him? It's just interesting to know what we would do? [LONG PERIOD OF SILENCE]

Figure 6.2 Examples of pharmacy students actively avoiding communication where they are unsure of the answer

Pharmacy students valued facts and assurance more than medical and nursing students, often referring to reference sources such as the BNF to provide their answers. This lack of assuredness has been reported amongst the pharmacy profession in multiple publications (164–166,215,229,244,245) and thus it is somewhat unsurprising that it was observed within our simulation. In addition to this pharmacy students lacked insight into team dynamics within the secondary care setting. As final year MPharm students they have varying levels of experiential learning which involve far less contact hours than 3rd year medical and nursing students, this result could possibly have been anticipated.

6.2.2 Berne's Model of Transactional Analysis as Applied to Communication in IPE

Eric Berne developed transactional analysis in the late 1950s and early 1960s as a method of psychotherapy which focused on people's interactions with others rather than their internal workings. As this field of psychotherapy inherently defines people by their interaction with others, it lends itself well to understanding how well a team is functioning and how interactions between different healthcare professions may play out in education and the workplace. Transactional analysis argues that individuals possess three ego states which in a healthy individual they should be able to seamlessly transition between; these are the Parent, Adult and Child, known as the PAC model (246).

The Parent is a state in which people act like their parents, or other authority figures from their childhood and adolescence. This normally manifests itself in authoritarian or nurturing tendencies in an individual. The Adult is a state in which a person objectively thinks about reality and approaches a situation dispassionately with appropriate emotion as and when necessary. The Child is a state where people think or behave in a similar manner to how they did in childhood; this can be split in turn into the 'free child' which is often associated with heightened creativity and inquisitiveness, and the 'adapted child' which is associated with survival techniques such as being afraid, anxious or trying to please (247). In transactional analysis an individual is often represented by the diagram in Figure 6.3 below.

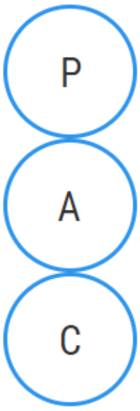


Figure 6.3 The model of an individual in transactional analysis, P = Parent ego state, A = Adult, C = Child

All communication between individuals can be related to the above model, for instance in healthcare teams the ideal communication level would be between the Adult states of two or more individuals. However in some cases communication will be mediated via a Parent-Child relationship, (for instance a junior doctor doing as a Ward Sister says), as long as both individuals are happy to communicate on this level then both these forms of communication are termed complimentary and will lead to positive outcomes (Figure 6.4).

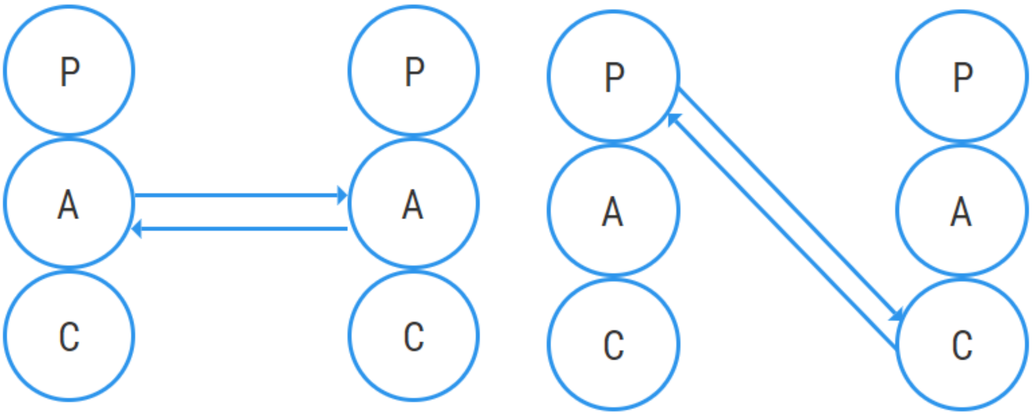


Figure 6.4 Examples of complimentary communication between two individuals

During the simulation, participants communicated with each other using both complimentary methods described above. Adult-Adult interactions were observed frequently with the example below (Figure 6.5) (Cf Figure 3.4) demonstrating how a pharmacy student politely dealt with some professional challenge from the medical students:

P002:	Suggests/prescribes a drug.
D001/D003:	Ask P002 specifically about another possible drug to prescribe.
P002	Politely disagrees with D001/D003 based upon his pharmacy expertise and gives specific advice.
D001	*'How much do we give?'*
P002	Provides dosage.

Figure 6.5 Example of an Adult-Adult transaction

Child-Parent transactions were also found amongst student groups, often these were framed as requests for help or direction from other members of the team (Figure 6.6).

D001/D003	Consult each other on possible treatment options depending on diagnosis.
P002 –	[Directed towards D001/D003] *'So do you want me to find an alternative drug?'*.

Figure 6.6 Example of Child-Parent transaction

In some cases an individual may respond to a request from an inappropriate ego state to the initial request, this will lead to a communication breakdown and will result in a different outcome to the original intention. An healthcare related example of this interaction would be a pharmacist asking a doctor to correct a prescription to a correct dose as per guidance (acting as the Parent in the situation); the doctor may react negatively to being asked to portray the Child, and then reverse the situation by attempting to bamboozle the pharmacist with his superior physiological knowledge (acting as Parent to put the pharmacist in their place as the Child), this inevitably leads to a stand-off where either adult conversations have to be initiated or an individual backs down and accepts their lot as the Child. This single breakdown may perpetuate avoidance of communication, or negative perceptions of individuals within the healthcare team, which may lead to poor patient care in future cases. Individuals initiating conversations on the Adult level may receive responses from Parent or Child ego states necessitating adaptation of the collaboration, these are known as crossed communications (Figure 6.7).

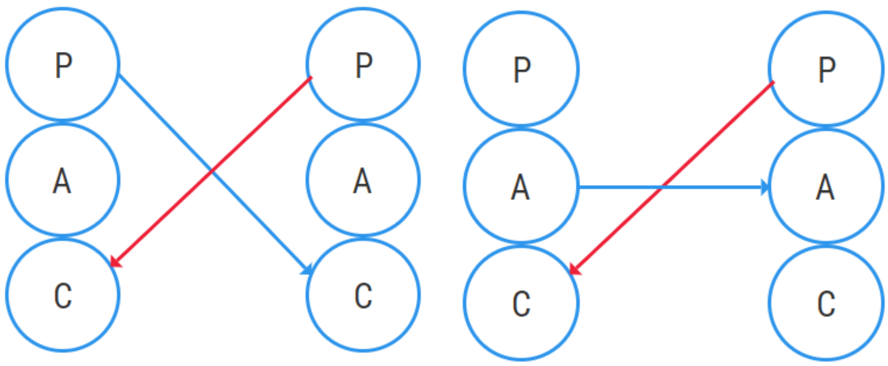


Figure 6.7 Examples of crossed communications between individuals

One example of crossed communication occurred between a medical and pharmacy student. During this transaction the medical student initiated a conversation at the adult level asking the pharmacy student *'What treatment would you give for H.influenzae?'* The pharmacy student responded to this request by ignoring it, acting as the 'adapted Child' rather than articulating an Adult response such as 'I'm not sure, would you like me to look it up?'

Positive and negative examples of communication were observed during the simulation suggesting that the simulation may be used to improve student awareness of their competencies and deficiencies. It is important to note that these behaviours were uncovered using real-time observation in partnership with the simulation. If the primary endpoint of an IPE intervention focuses on improving communication between participants, it is unlikely that an asynchronous version of the simulation in its' current technological state would uncover these behaviours.

6.2.3 Reliance Upon and Benefit of Each Other

As mentioned previously one of the key aspects in developing an interprofessional simulation is ensuring that participants have tacit knowledge to complete part of the simulation, but not all of it. In our study this forced students into collaborating with each other as they relied on each others' skill set.

P030: Asks D010 about Chest X-ray D010: Explains medical basis of crackles

Figure 6.8 An example of reliance on each others' knowledge

Lecturer participants followed this model in a slightly more direct and efficient manner befitting their status as proficient or expert practitioners (97).

"…like I said to you, I'm not sure about dose and I turned to my pharmacist here 'what is it?'" [NL01]

Participating students introduced the concept of the 'experienced student', one who is aware of their own and others' skills and limitations. This would be an individual operating at the conscious-incompetent/conscious-competent interface according work by Kruger and Dunning (223), or the advanced beginner/competent interface in Dreyfus and Dreyfus' model adapted by Benner (97). Team intelligence requires members to understand each others' role and work imperatives in order to deliver a common goal. Other important factors are team members must share information, cross-monitor each other and coach all members of the team no matter what their place in the hierarchy (168). An awareness of others strengths and weaknesses is vital to good IPE, and multidisciplinary teamwork. This awareness enabled students in our simulation to take the lead at appropriate times in the scenario, based on their own perceived competency. Frequently nurses would take charge of monitoring, oxygen administration and the initial stabilisation of the VP, pharmacists would provide expert advice on prescribing and medics would formulate a plan and explain the clinical findings objectively based on their physiological knowledge. Medical students would tend to take the lead in the scenario if there was no particular need for specialist input from nurses and pharmacists; sometimes referring to the slow real-time nature of the simulation as '*tedious*'. Collaboration based on areas of expertise combined with increased acuity tended increase interactivity between team members and improve the collective responsiveness to the VP. If students successfully dealt with a crisis then this interactivity continued with students actively questioning each others' knowledge base in order to expand their own skill set. This mirrors Hackman's thoughts on the importance of leaders encouraging input from their teams: *"If leaders are receptive to suggestions, others are more likely to offer them"* (248). It also demonstrated student groups sharing commitment, identifying clear roles and modelling interdependence; becoming the highly effective healthcare teams described by Reeves et al (239). Students acknowledged their knowledge gaps and were positive with regard to their collaboration with phrases such as *"We bounced ideas off each other"* and *"you get an idea of what everyone else is looking for"*. When this occurred students were truly learning *about* each other.

Adoption of clear roles by students, based on their perceived competencies created a notable improvement in patient care, students felt comfortable caring for the VP in this way, which in turn increased their communication with each other. This suggests the 'home domains'

(Figure 5.3) form a focus for collaboration, providing safe 'fall-back' characteristics and job roles during acute events. Following these acute events collaboration was improved as other students had a greater knowledge of both the skill set of others, but also their perspective of patient care.

Reliance on each other was observed to be tempered by pragmatic expertise. Rather than blindly following recommendations of the 'expert', challenges based on past experience were brought to the table. One particular example of this behaviour involved medical and pharmacy students suggesting a paracetamol prescription for pyrexia, in this case the nurse advised against the course of action in order to more closely monitor any deterioration (Figure 6.9).

D003 – [Directed at P002] "*How much paracetamol do we give?*" P002 and P003 – [Consult each other and give advice] N002 - *"But his obs may come down with that, what else can we give him?"* Uses her experience and knowledge to demonstrate that it is inappropriate, but still relies on pharmacists' further knowledge about alternatives.

Figure 6.9 Conversation between participants demonstrating explicit reliance on each others' knowledge.

This provides an excellent example of what Berne would term an adult-adult transaction within his framework of transactional analysis (249), clearly all parties are aiming to treat the patient appropriately and are using collaborative and respectful approaches to communicate with each other. Objective information from the medical and pharmacy students was acknowledged and adapted to patient need objectively by the nursing student. Challenge was certainly not the only way students collaborated; they would also support each other in the decision making process often confirming each others' theories and suspicions, this improved student confidence in the scenario because *'you have the support of your team'*.

Students actively used 'ego strokes' to build team relationships both during and after the simulation. Berne described the stroke as the fundamental unit of human recognition, positive strokes are perceived as pleasant by the receiver, negative strokes are unpleasant (247). Frequently students would give positive feedback to each other in de-brief situations, with adjectives such as 'amazing' being used to describe other professionals skills sets. Students also acknowledged their own limitations, but these weakness were shared. If one professional group admitted a weakness another group would often cite their lack of expertise in another area of the simulation (Figure 6.10).

> *"yeah, there were certainly parts I'd have no idea about, like X-rays or mechanical ventilation. If you showed me an X-ray I wouldn't know what to look for."* [P003]
>
> *"sort of likewise on drugs as well, dosing and stuff."* [D001]

Figure 6.10 Students 'sharing' their weaknesses with each other

6.2.4 Professional Debate and Disagreement

Observational data revealed students disagreeing with each other on a professional level, a crucial aspect of any Adult transaction and of a high-functioning multidisciplinary team. In the simulation both nursing and pharmacy students disagreed at points with medical colleagues, with the medical students accepting or listening to their advice. This demonstrates students avoiding a traditional physician power dynamic, and promoting truly collaborative practice; refuting Kuper and Whitehead's concerns about IPE maintaining or reaffirming power within the medical profession (82). In focus group feedback in phase 2 students actively denied disagreeing with one another framing it as debate. This points to a one of the unwritten 'rules' of interprofessional education, that everyone has to be 'nice and respectful' of each other. Of course, professional respect is vital in any team, however it is important deficiencies in work are highlighted. IPE must not be viewed as a 'charm school' (168), and effective communication does not involve being nice, it is caused by creating effective practises of communication (236). In our study, students were possibly afraid of either disagreeing with each other, or being seen to do so, as it contravenes the overarching aim of IPE to improve cohesion amongst the professions. One could say that IPE is viewed as a politically correct form of education, one in which students feel unable to criticise each other face to face, but also unable to criticise the process. More evidence for this hypothesis was provided for when the students were given the option to provide feedback on a uniprofessional basis. The pharmacy-only group saw far more stereotypical behaviour (by pharmacy students role-playing other professions) during the simulation. In focus groups following the simulation pharmacy students criticised the commitment of other professions to IPE in general. This strengthens a phenomenon reported by Reeves in 2012 in which professionals are reluctant to criticise other healthcare professionals because they will have to work with them in future (62).

Despite active denial of disagreement students employed a number of techniques which allowed them to disagree on a subconscious level. Students with greater knowledge or experience would often 'steer' other less able students to agree with their way of thinking; this tended to occur when an irrelevant suggestion had been made by a student and the others would move on to another topic of more relevance within the simulation. This professional steer is an example of what Berne would term as a Parent-Child transaction with the more able students taking the role of the Parent in this situation, again this can be a useful form of communication as long as the less able party is happy to take the role of the Child (250).

Disagreement and challenge are regarded as crucial to effective IPE, professional participants were happy to challenge each other, but as experts were more confident in their dealings with the VP and their knowledge of the skills of other professional groups. Student participants were more reluctant to challenge each other but used a number of direct and subliminal techniques to debate with, influence and challenge each other in a non-confrontational way.

6.2.5 Who prescribes?

The simulation deliberately left the question of who prescribed treatment for the VP open for the participants to decide for themselves. Professional participants all took responsibility for prescribing and reached a collaborative decision before administering treatment. Both pharmacy and physiotherapy lecturers felt their profession should influence prescribers in practice by 'making doctors think'. Student prescribing decisions were also collaborative with the lead prescriber rotating through the professions dependent on the situation. Pharmacy students were notably reluctant to take overall responsibility for prescribing when medical students were present. In this situation they preferred to play the role of advisor, where they were happy to suggest drugs, doses, routes, duration and intervals; but not happy to initiate treatment unless the medical student was in agreement. In focus groups students praised the open nature of the simulation for encouraging collaborative decision making. Students thought it did not place responsibility directly on the doctors shoulders, and gave the professions opportunity to prescribe or advise as they saw fit. This behaviour should be regarded as a positive finding as it reinforces the ability of other professions to influence and contribute to traditional physician decisions (82). In practice doctors have complained that other professions have not taken enough responsibility for patients in shared care arrangements, giving nursing and pharmacy students this opportunity prior to qualification may inculcate responsibility taking behaviours in future practice (231).

6.2.6 Pharmacist as Conduit of Information and Deference

Early in the simulation before the acuity increased with the sounding of alarms nursing students and medical students were observed to be managing the patient but not communicating. They were working side-by-side but not actively consulting each other; this was one of the major causes of failure of care in the Morecambe Bay Hospital investigation (241). Suzanne Gordon once described healthcare teams as: *'intimate strangers engaged in parallel play at a patient's bedside* (168).*'* In the early stages of the simulation the pharmacy student often acted as a conduit of information between the doctor and the nurse; almost as if the other professions viewed the pharmacist as a neutral middle man; the theoretical mediator. This is somewhat contradictory to the natural course of events in the ward environment where often the nurse will mediate between the pharmacist and doctor; acting as the humanistic mediator (251). The nurse often takes up this role in hospital due to their proximity to the patient, nurses will always be present on a ward; doctors and pharmacists are more transient and as they have competing priorities and work streams they may find they have no opportunity to interact with each other face to face (252). In the simulation the pharmacy student took on this role in the early stages of the simulation due to their relative lack of experience. The early stages of the simulation tend to concentrate on diagnosis (the natural realm of the doctor with interjections from nursing) and observation (the realm of the nurse). As the pharmacist was not directly involved at this stage the other professions tended to bounce ideas off, or communicate with the pharmacist rather than directly with each other.

This role of the pharmacist was facilitated by students often taking a back step or the quiet role of observing early interactions with the VP. In addition to this, pharmacy students would often be deferent to medical and nursing students within the simulation; asking others what they thought before providing their specialist knowledge. Deference could be regarded as a weak or submissive behaviour by the pharmacy student, which is not something which would be explicitly encouraged as part of an IPE intervention. Previous studies have noted that deference may serve a purpose in the context of interprofessional collaboration (253), this will be explored further in chapters 6.3 and 6.4. It was already noted that patient care suffered when the group had a lack of direction and no clear leader, deference may allow a leader-sub-ordinate relationship to develop. If this is combined with effective followership behaviours such as inquiry, advocacy and assertion (168) deference could contribute to more effective working relationships and ultimately better patient care.

6.2.7 Other Collaborative Behaviours

When students were asked to play the role of another healthcare professional it gave them first-hand experience of the pressures and stressors of other roles. This increased their empathy and understanding towards one another, which should result in more collaborative practises in future years. Students articulated this point by saying *'We don't know what other people do'*, this leads to a key point required to develop a successful IPE intervention. In order for IPE to work effectively participants need to be aware of their own role and the role of any other professional caring for a patient.

Student participants cited the overarching hierarchy in healthcare as a barrier to effective collaboration. Whilst hierarchical relationships were not played out by participants in the study, all participants had some experience of hierarchical relationships in the working environment. Many of these anecdotes shared within focus groups related to power relationships within the medical profession. Although undergraduate medical students may not be reliant on supervisors to progress with their study, junior doctors certainly rely on good references from supervisors to gain access to or continue with speciality training. Students articulated the fact that *'it's difficult to argue with or challenge your manager in the workplace'* showing the influence that future relationships have on limiting negative feedback provided to others, especially those in positions of authority. The lack of protected disclosures from junior staff played a significant role in the Climbé case as well as the Francis report (1,35), both of which advocate the increasing use of interprofessional education. The 'Freedom to Speak up' review (2014) argued for greater protection for trainees who report unsafe practises. Trainee nurses gained legal whistleblowing protection under the Employment Rights Act in 2015 (254). Only after a long court process involving the suspension of a trainee did junior doctors gain this level of protection in 2018 (255).

Our findings seem to challenge the dogma that interprofessional education alone will help to improve patient safety and reduce failure in healthcare; because it does not deal with the hierarchical challenge provided by one's own profession, or the greater healthcare system. It is clear that the healthcare system is resistant to change. In a similar manner to Wackerhausen's analogy of professional immune systems (86), governing bodies made legal arguments to refute trainees who spoke out against unsafe practises (254). This clearly provides students' with a hidden curriculum reinforcing the need to 'get along' with senior colleagues rather than asserting the need to improve standards.

Students also reported hierarchical behaviour between medical students and other professionals in the setting of the hospital ward. Often this was cited as medical students *'thinking they're already doctors'*, and attempting to pass on menial tasks to other members of the healthcare team. This behaviour would often be challenged by nursing staff (Figure 6.11), but may lead to underlying resentment.

D010:	*I think you get a lot of hierarchy in Medicine as well. Unfortunately, you get the medical students who do think they are already doctors (but not me). They say, 'Can you do this?' or 'Can you do that?' You think, 'You're a medical student.'…I think a lot of them haven't had jobs before. They've not worked and they've not been in the real world. They don't really understand. From their background, they think that everyone is below them. On the ward, they're like, 'We're the best. We want to follow a consultant or a surgeon.'*
N010:	*They badger the nurses for bloods but I've got five other patients that need care. He said, 'If I do the EBG or ABG, can you go and run it?' I'd said, 'No, not at the moment'. I said, 'It will be faster if you go and do it yourself, if you want it doing now because I'm busy.' ….*

Figure 6.11 Anecdotes of attempted hierarchical behaviour from medical students

Nursing students also articulated other subliminal behaviours they would use if they disagreed with a treatment plan for a patient. This showed some acknowledgement of a power relationship whereby the nurses would follow doctors' orders, but to a limit. If the nurses disagreed with the treatment plan proposed, the phrase *'Crack on doctor'* was used showing the nursing student leveraging some power over the situation by allowing the doctor to undertake what the nurse thought was an unnecessary task alone.

Hallin and Kiesling (81) cited hierarchy and inequality as factors which reduce the interaction within an interprofessional ward environment staffed by undergraduate students. The introduction of a qualified professional working alongside students would change the power dynamic within the team, with less open questioning of the processes used to care for patients due to the introduction of the 'powerful' qualified professional. In the real-world environment, undergraduate students will work with each other once qualified, but they are also subject to hierarchical relationships from within their own and others' profession.

Undergraduate IPE fails to take into account the complexity of working within healthcare teams in the real world as it often does not deal with hierarchical dynamics. Hallin and Kiesling's findings argue that learning is lost when hierarchy is introduced to the process (81). In order to facilitate optimal learning *with, from and about each other* IPE must avoid modelling the realistic hierarchical relationships students will be exposed to on qualification, and adopt a more egalitarian approach where learners can view each other as important resources of information (168).

6.3 Intrinsic Behaviours

This theme contains a number of behaviours tangentially related to aspects of communication, teamwork and personality characteristics of participants. In the results they were divided into positive traits, leadership qualities, followership qualities and negative behaviours.

6.3.1 Positive Behaviours

Care and engagement with VP

Participants all demonstrated a desire to care for or engage with the virtual patient, treating it as if it were a real person. Participants cited the fact the avatar demonstrated visual characteristics similar to real patients with COPD as beneficial, for instance blue fingers (a sign of peripheral cyanosis) acted as a visual cue for participants to prescribe oxygen. Visual data was not the only way in which participants formed emotional bonds with the virtual patient; updates in vital signs and blood test results gave participants information to act upon in real time. The increased responsiveness of the virtual patient when compared to a paper-based scenario was universally described as a positive aspect of technology, increasing engagement and 'suspending reality'. One participant even described the simulation as addictive, stating *'you can't take your eyes off it.'* This addictive behaviour was observed in participants who hyper-observed their virtual patient; these participants monitored the VP too closely which resulted in a detrimental outcome. Increased acuity within the simulation itself (for instance if an alarm was sounding due to a dangerous vital sign reading) increased participant attachment and the immersion in the scenario. These findings reflect previous work in the area demonstrating both positive educational outcomes and empathy with the use of virtual patients (115,118,256,257).

Experimentation and Confidence

Deliberate practise and mastery learning are two key learning concepts in medical simulation suggested by a major review by McGaghie *et al* (107). Deliberate practise and mastery learning often focus on improving a practical skill repetitively until one becomes proficient. Rather than facilitating deliberate practise, students thought the simulation allowed them to experiment with different care plans and techniques allowing them greater freedom than they would have in a classroom or experiential environment.

"I think this is better though, well not better but like good because you're more confident with your choices because it's not an actual person…. and if it's wrong then it sticks with you because they die." [P015]

Students treated 'death events' as if they were a 'paradigm experience', an event which according to Benner will have lasting impact on future practice (97). When asked what they had learned from the intervention one student responded *"don't give anyone 100% oxygen"*, clearly articulating the impact of the simulation on their learning. Decisions made by students in the simulation would be made by post-registration professionals in practice. The simulation forces students to take responsibility without supervision giving them a degree of autonomy which in turn may increase their confidence.

The teamworking aspect of the scenario also improved confidence amongst both qualified practitioners and students alike. Being part of a team, or having colleagues with differing perspectives was cited as a confidence booster, as individuals could share responsibility.

Despite some instances of deference, decision making processes were truly collaborative with medical students valuing the input of their colleagues for prescribing decisions.

N010: You know you need to prescribe antibiotics but...

D010: I didn't know which one [laughter].

This reflects recent work by Axon *et al* (258) who interviewed F1 doctors on their interactions with other members of the multidisciplinary team. F1 doctors trusted pharmacist recommendations however, they would often only decide to act on them if more senior members of the medical team agreed with that particular course of action.

Confidence only increased when decisions taken resulted in a positive outcome within a short timeframe. If a desired effect from treatment was not seen within that time, students started to doubt themselves and review their actions. Negative responses from the VP and practical real world experience often attenuated confidence amongst some participants. This made participants more watchful and aware of the potential for complications in patient care. Overconfidence is often associated with unconsciously incompetent students (the Dunning-Kruger effect) (223). Attenuated confidence seen in some participants after a 'death event' demonstrates the ability of the simulation to improve a student's perception of their own ability; pushing some students from the unconsciously incompetent towards the consciously incompetent and competent domains of practice (223).

6.3.2 Leadership Behaviours

Risk-taking Behaviour

An increase in risk taking behaviour was both observed and articulated by some participants, *as 'The patient wasn't real'*. This could be viewed as students adopting an experiential learning style, attempting unorthodox therapies as they realise their actions will not be life threatening. Gamification of medical education has been shown to be effective at improving knowledge sets and increasing opportunity for hard-to-schedule learning (146), however to my knowledge there is no prior evidence linking it with risk-taking behaviour in undergraduate healthcare students.

Students also acknowledged they did not ask for help as quickly as they would in a real-life situation, again this should be viewed in a positive light as students are appropriately modelling behaviours of their qualified equivalents. Participants felt the VP would be more realistic if it could respond to a wider variety of questions, with responses such as *'I would like a little chat with him'*, pointing to the more nuanced methods of communication employed by participants in real world settings. To address this finding was above and beyond the scope of this study due to time and technical considerations.

Bravery

Another emotional response elicited from participants was bravery (or lack of it). Participants demonstrated bravery when they continued with their initial treatment decisions in the face of conflicting data. This has already been discussed as making students 'nervy', however these specific situations tended to elicit either cautious watchfulness (a brave response), or desperate measures (even amongst experienced practitioners). These situations tested higher clinical reasoning skills, often if they could justify what was happening to the VP on a pharmacological and physiological basis then no treatment was deemed to be necessary. This was rare however, most frequently it was observed that students tended to struggle if a situation was outside their understanding of the subject matter. This occurred if a nurse had not seen a situation before, or if a pharmacy student had no guidance to follow, medical students attempted to reason their way through any event like this, reflecting their training in trying to reassure other members of the healthcare team (166,167). In the second phase of the study, students acknowledged that the simulation itself forced them to be brave with decision making due to the time pressure placed upon prescribing decisions. The fact of challenging other professional groups was also thought to be 'a brave behaviour' even if the challenge emanated from a traditionally powerful source (e.g. the medical student) as conflict was to be avoided. Participants were also found to attenuate their bravery if they attempted the scenario for a second time, for instance students would be more cautious in fast-forwarding time as they had previously seen how quickly the patient could deteriorate, thus demonstrating an ability to reflect-on-action as necessary for competent clinical practice (97).

Decision making

Participants commented on the manner in which the interface forced them into making detailed decisions for their patients, above and beyond those they would make in either an experiential setting (where they would not be responsible for that level of process) or in a classroom based setting (where they could get away with choosing classes of drugs). This in turn was cited as a way of boosting their confidence when it came to decisions of the sort in the future. The decisions to be made in the simulation all related to prescribing and ordering laboratory tests, traditionally the domain of the doctor. Despite the increasing uptake of non-medical prescribing in the UK over the past twenty years, medical students are the only profession licensed to prescribe at the end of their pre-registration studies. The interface was designed in order that all professions had the ability to prescribe and frequently a collaborative decision was made between all available professions. Collaborative decision making is a good indicator of a high-functioning team, as decision making can potentially become a competitive activity in groups that are teams in name only (168). In contrast to our study, recent work by Abuzour *et al* demonstrated non-medical prescribers avoiding prescribing when doctors were present (259) or failing to take adequate responsibility for patient care (260). Three main factors were believed to contribute to the forced decision making process a) the gravity of the situation in the simulation, b) the level of engagement of the student and c) time. All participants recognised the need to make a prescribing decision in good time if the situation necessitated it, however because they had been forced to make the decision quickly this left students feeling either hopeful or helpless as they *'were heading into the unknown'*. Hopeful feelings were followed by relief when a decision was found to be improving the condition of the VP, or by further anxiety if the situation deteriorated further. Decisions were taken in one of two ways: either based upon the pragmatic reality of the case (e.g. what the present vital signs are) or according to a theoretical approach of what should be done under such circumstances. Pharmacy students favoured the theoretical approach, medical and nursing students the more pragmatic approach mirroring their professions' home domains of care and education (Figure 5.3). Despite this separate approach all groups tended to struggle to act when the VP responded in an unexpected way to any intervention. Difficulties in transferring learning from classroom to practical real-world situations have been well recognised for many years; this simulation appears to be another way of ameliorating this divide by allowing students repeated deliberate practise in a patient-safe environment.

Patience

Two facets of patience useful for healthcare practice were demonstrated by participants in the study: patience with a treatment (or patient response) and patience with each other. Patience with treatment was inherently linked to bravery and having confidence in one's own ability. Patience with each other demonstrated participants learning *about* each other according to the CAIPE definition of IPE (169). Again this fed into three themes such as learning about each others' pressures, patience with each others' limitations or 'making excuses' for each other. Patience with each other's limitations was described in terms such as *'nurses were patient whilst I looked for things'* in focus groups, demonstrating students valuing patience as a method of increasing collaboration.

Calmness under Pressure

A minority of participants also demonstrated calmness under pressure in a difficult situation in the simulation, a key characteristic of an experienced healthcare professional. This correlated with more collaborative group dynamics and previous experience in the field.

Tacit knowledge allowed students to know when a patient was stable and also allowed them time to think if the situation became more difficult. The more capable students would often pause the scenario to allow themselves the time to think logically about what was happening to the VP.

"there was no…sense of urgency to the event…it gave us time to sort of sit back and evaluate the situation." [N006]

Although this is not possible in reality it is somewhat reassuring to see students taking the time to reflect-in-action on their diagnoses and treatment plans to ensure positive patient outcomes. Gordon *et al* strongly argue that the development of team intelligence allows individuals to become hyper organised during a crisis. It is extremely encouraging to see that some student groups are already exhibiting the characteristic behaviours of highly effective teams (168).

6.3.3 Followership Behaviours

These behaviours may be considered as more introverted or submissive compared to those discussed previously. They contribute to the effectiveness of high-functioning teams, as it is just as important for junior members of the team to demonstrate active followership and to inquire, advocate and assert their position to authority (168).

Seeking Reassurance

Student participants were often seen to be uneasy regarding the lack of supervision; external reassurance from lecturers and facilitators was often sought especially when the VP's condition was deteriorating. As previously stated participants believed having colleagues with them in the simulation increased their confidence, some of which was mediated by seeking reassurance from each other. This was articulated as *"safety in numbers"* with participants wanting to share both responsibility but also blame if things went wrong. Pharmacy students were observed to desire a particular form of reassurance with respect to the use of the British National Formulary (BNF); often they would feel incapable of offering an answer without the reassurance of the reference source to reinforce their argument. This may relate to the pharmacist's natural home as the objective theorist in the multidisciplinary team (Figure 5.3), with the BNF providing the theoretical basis for the pharmacists objective recommendations.

A related phenomenon to reassurance was observed in phase one of the study when lecturer participants expressed a desire to refer the case to a senior practitioner (often a consultant physician). This would reflect standard practice in a UK hospital where consultants will be available within the hospital between 7am and 8pm weekdays (261); and there will be on-call cover at evenings and weekends. The participant who strongly advocated for a 'refer to senior' option was a qualified nurse with expert knowledge in the management of patients with respiratory disease. Before contacting a consultant normally help would be requested from junior doctors; and the decision to contact a consultant would usually come from a senior member of the healthcare team (medical registrar, nurse in charge etc). The desire to contact a senior was not strongly expressed by student participants in the second phase of the study. This could possibly be due to misplaced confidence correlating with practitioners at lower levels of competence (223). Conversely as the participants were all pre-registration professionals they may not yet have developed the confidence to request help from the most senior members of the healthcare team. Preferring to liaise with healthcare professionals closer to their rank. This could possibly point to issues with hierarchy, where juniors are afraid to discuss cases with more senior colleagues for fear of losing 'face'. It is well documented that traditional imbalances of power contribute to people feeling awkward during communication, the contribution of hierarchy to miscommunication in healthcare will be discussed below with reference to the results (168,234).

Deference, Diplomacy and Abnegation

All healthcare students demonstrated behaviours designed to placate other members of the team; or to avoid themselves from losing 'face'. This occurred most frequently when students were out of their 'comfort zone', for instance when they had no tacit knowledge of what to do in a particular situation, when they had no prior experience (e.g. in role reversal) or when they believed others were better prepared or equipped to deal with the situation.

Brown and Levinson define 'face' as "the positive social value a person claims for himself by acting in a particular way" (262). Their theory of politeness provides a valuable framework with which to evaluate team interactions. There are two sides to the face: the negative face is the wish to not have one's actions impaired by others, the positive face is the desire for one's actions to be desirable to others. A face threatening action (FTA) is defined as an action which may endanger one's own or another's face. Three factors influence the weight of a face threatening action: 1) power 2) social distance 3) the culture specific ranking; as the weight of a face threatening action increases then the speaker delivering the FTA is expected to choose a more polite strategy to deal with the issue (Figure 6.12)(253).

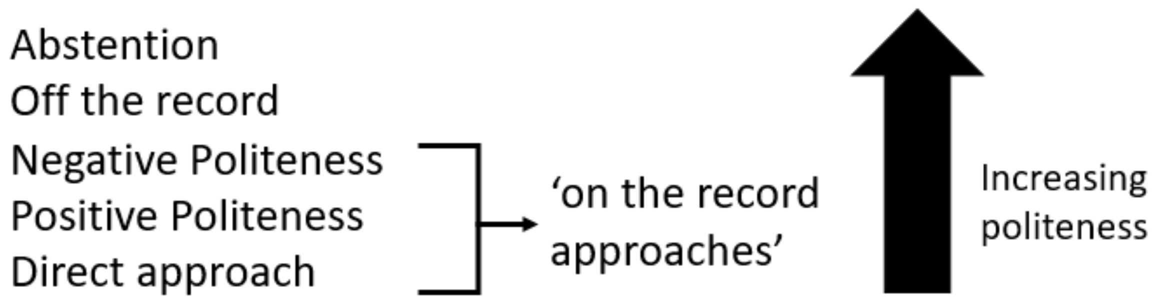


Figure 6.12 Hierarchy of politeness strategies according to Lambert, 1995 (253).

Off the record approaches are considered the most polite method of communication but may result in no change in approach from the listener. They may involve a complete avoidance of the matter, or communication on an ulterior level according to Berne (246) where the speaker will hint at what he wishes the listener to do. No examples of 'off the record' approaches were witnessed in the study, however a student nurse alluded to using it with medics in one previous experiential situation:

"But then that would be down to the doctor's decision for prescribing it and if we weren't comfortable, we'd question it but then we'd also say, 'Crack on, doctor.'" [N010].

Hinting and hoping is often used by courteous people who wish to avoid confrontation, to reserve another's sense of dignity or to protect themselves from criticism and rejection. Off the record approaches such as those above are highly ineffective at improving team intelligence and are extremely dangerous when used in acute situations (168). Research in the aviation industry reveals sub-ordinates such as first officers using 'off the record' approaches to communicate with their Captain when an aeroplane has been in immediate danger. Root cause analysis has revealed off the record communication resulting in accidents with the consequent loss of many lives, including of those who were afraid to lose 'face' (263).

On the record approaches involve either a direct request with no regard for the consequences or an attempt to mitigate the face threats by a positive or negative politeness strategy. Negative politeness strategies appeal to the listener's want to not be disturbed and may involve the use of phrases such as *'sorry to bother you'* or some deference such as *'May I please suggest an alternative'*. Positive politeness strategies may include the accompaniment of bad news by praise, or assertions of common experience e.g. *'You must have overlooked this.'*

Medical students have been shown to identify strongly with their profession as opposed to their student peers (230), and the medical profession is regarded as an important and well regarded social group with characteristics such as self-confidence, power, dedication and dominance attributed to the profession amongst others (166,230,234,264). As a result one would expect the medical students to be less likely to use politeness strategies when communicating with their peers. Pharmacists are often considered to be a middle ranking profession, in the UK they have been referred to as belonging to the technical middle class (265), pharmacists have also been referred to as 'Canadians compared to the Americans of the medical profession' or 'coming from Lewisham as opposed to Knightsbridge' (166). As a result it is expected there will be some power and social distance between pharmacy and medical students; with a degree of politeness used when the pharmacist approaches the doctor. Nurses are considered to be established middle class professionals with a tendency to suffer from stereotypical characterisations such as being 'the handmaid of the doctor' (266,267). As a result the power differential between the nursing and medical student is expected to be most pronounced. Nurses are expected to be skilled technicians, however their training is often not viewed to be as extensive and intellectual as that of pharmacists and doctors (268); thus they carry less 'educational power' in transactions with the other professions.

The results of our study reveal students playing out these power relationships at a subconscious level. Pharmacy students were revealed to be deferent in both interactions with medical students and in some cases nursing students. On two occasions pharmacy students used negative politeness in order to defer to medical students. Pharmacy students deferred prescribing decisions back to medical students despite a direct request, following a traditional prescribing paradigm (Figure 6.13).

D003 – Directed to P002 *'Want to give him steroids?'*

P002 – *'It's up to you'*. Makes doctor make the decision, but provides advice on which steroid to prescribe.

Figure 6.13 Pharmacy student deferring to medical student over a prescribing decision

In addition to this they were observed to defer to other professions due to their lack of subject specific knowledge (Figure 6.14).

P001 – To both D002 and N001, *'In that situation, what would you do?'*

D002 and N001 consult each other about what they would do, ie physical interventions rather than drugs.

Figure 6.14 Example of pharmacist asking for support in their understanding of the situation

These are both examples of pharmacy students employing a negative politeness strategy. Observational data also revealed pharmacy students taking a back step in the early stages of the simulation due to the emphasis on diagnostics and medical stabilisation at this stage of the simulation:

"Initially D002 was the dominant member of the group, P001 remained fairly quiet and controlled the iPad, following actions suggested by D002 and N001." [Independent Observer]

This strategy can be interpreted as an off the record interaction, with the pharmacy student happy not to challenge the other professional expertise at this stage of the simulation.

One of the paradigm relationships taught on the MPharm course is the doctor-pharmacist relationship. This interaction is often taught in dispensing classes as a conversation which will play out as follows: *'I need more information on this Prescription, Doctor'*, or *'Have you considered this interaction?'*, or *'I really think this should be changed'*. These stereotypical interactions portrayed in low fidelity simulations seem to cloud the relationships observed between final year MPharm and medical students during our simulation making the pharmacy students somewhat subservient and deferent. This relationship has its' basis in the advent of the NHS and reforms to the healthcare system since that date which has made the primary care relationship between pharmacists and GPs more subservient (via dispensing prescriptions) as opposed to the competitive relationship of the 19th century (6).

The strategies employed by pharmacy students in the simulation model those expected in Brown and Levinson's theory of politeness, however they also model behaviours demonstrated by pharmacists in the published literature. Denvir and Brewer argue that medication therapy recommendations brought forward by pharmacists to physicians are naturally disjunctive to team dynamics, and that a little deference helps to soften these disjunctions in order to maintain team function (269). They argue that deference is not a sign of powerlessness but a *"situationally adaptive form of communication within a hierarchical structure."*   Participants in Denvir and Brewer's study used the analogy that the physician is *'the Captain of the ship, whereas the pharmacist is the first mate'* reflecting Austin's analogy that pharmacists are the lower powered members of the healthcare team. Lambert (1995) discovered pharmacy students using negative politeness strategies with high frequency when reporting allergies, or making a recommendation to a simulated physician (253). Lambert argued that these negative politeness strategies reinforced the existing professional roles, divisions of labour and power relationship within the professional team and may prove a barrier to the expansion of the pharmacist role. Lambert's paper was written when pharmaceutical care was considered to be a fairly new concept, it is of some concern that over twenty years later pharmacy students are still using these negative politeness strategies when they interact with medical students.

In contrast to pharmacy students, medical students were found to use different strategies to deal with their own knowledge gaps. Positive politeness was used in a de-brief situation where a pharmacist described themselves as knowing little about the physiology and acute management of COPD, in response the medical student *said: 'likewise on drugs'* showing some empathy for the shared situation the students found themselves in. As stated previously students felt uncomfortable when asked to role play an alien professional role. In the final simulation the medical student was asked to role play a pharmacist. The medical student immediately demonstrated discomfort with this idea by stating *'Good luck with that, I know nothing about drugs.'* As the simulation continued the medical student tended to revert to type, dealing with the arterial blood gases and physiological changes in patient presentation; despite an attempt at authoritarian behaviour by the nurse (playing the role of doctor). Later in the simulation when the role of the pharmacist became increasingly important the medical student looked for a drug monograph in the British National Formulary, after a short period of looking without success the medical student threw the BNF in the direction of the pharmacist thus actively abnegating their area of responsibility in favour of someone they saw as more fit to deal with it.

D010: "I'm no good at drugs" then throws the BNF in P030's direction. [Observational data from MDT group]

This pattern of behaviour reflects the hierarchical position enjoyed by the medical profession in healthcare; rather than defer to others' expertise the medical student actively delegated responsibility to others they saw as more fit to deliver in the situation. This somewhat reflects a recent study by Axon and colleagues investigating the communication between foundation year (F1) doctors and hospital pharmacists. The communication between the two professional groups was generally positive with F1's stating that they *'had complete trust of pharmacists'*. Axon commented that the power differential between a newly qualified F1 and an experienced hospital pharmacist may not be great and in the majority of cases recommendations from hospital pharmacists were followed by F1s. When recommendations were not followed; this was due to a dissonance in opinion between the pharmacist and senior medical staff (registrar/consultant level) (258). This demonstrated that junior doctors view senior colleagues as having greater influence than senior pharmacists, reinforcing the hierarchy amongst the professions in the 21st century NHS.

Nursing students employed collaborative strategies with other professional groups when they felt their subject specific knowledge was of use in the simulation. Often they were very active in the initial stages of assessment and patient stabilisation, reflecting their role as the triage professional in accident and emergency. Later in the simulation once a patient was stabilised nursing students reported feeling isolated, or felt as though they had little contribution to make. In these circumstances nursing students tended to abstain from conversations using the most polite strategy available to them.

"…but I know for myself because at that stage I had no idea what the antibiotics that was down on the form then so, I was like so I didn't really have anymore to do." [N004]

This and the previous example a nursing student gave from practice are 'off the record' examples of Brown and Levision's politeness theory (262). As arguably the least powerful members of the healthcare team, especially in the sub-acute phase if the nursing student felt their knowledge was inferior, rather than initiate a potentially face threatening action they either avoid it, or use hints to explain their point of view to others. This may reflect a prevailing opinion that nurses have reduced status compared to doctors (266), and augment the opinion that the nurse is a 'skilled technician', happy to intervene where necessary but deferring to others knowledge when pushed or where hierarchy dictates it (267).

Hierarchy therefore plays an important role in interprofessional communication at the undergraduate level; students defer or delegate dependent on the relative power of their professions. This appears to be entirely predictable according to the politeness theory of Brown and Levinson (262). Hallin and Kiesling have noted that when a pre-registration student is replaced by a qualified professional in interprofessional education, the power dynamic becomes skewed and communication, collaboration and learning suffer as a result (81). As a result it is necessary to have healthcare professionals at similar levels of relative study in order to facilitate a successful intervention. Our study selected final year nursing and pharmacy undergraduates alongside third year medical undergraduates. Although the medical students were further away from qualification this dissonance did not affect the collaborative and communicative nature of the simulation. Medical students modelled hierarchical behaviours on occasion commensurate with their position as leader of the healthcare team, however in most cases and always in the de-brief the collegiate nature of learning with, from and about each other was appreciated and advocated by students. According to Hallin and Kiesling and many others IPE should not model traditional hierarchical structures within healthcare, and if it does then it may be considered as a method of maintaining physician power (81,82). Despite our best efforts students subconsciously modelled both hierarchical and stereotypical behaviours commensurate with their individual professions. This may be due to what Gilligan *et al* describe as the 'hidden curriculum' (207) the lessons students learn without being taught; such as behaviour modelling and stereotypical interactions conveyed as vignettes by experienced lecturers to teach other areas of practice.

Cautiousness

Student participants demonstrated reasonable levels of cautiousness when treating and diagnosing the patient. In some cases this was detrimental to patient care and took the form of hyper-observation, which often resulted in over treatment and impatience with correct treatment plans. In other cases students would paralysed in the face of ambiguity or conflicting data (164), which would result in inaction or a 'hopeful' cautiousness exampled by phrases such as *'I hope he'll be alright'*. This behaviour was often modelled by pharmacy students, who tended to worry about the minutiae of changing vital signs to the detriment of the wider care of the patient. For example, in one group pharmacy students focused on prescribing the correct inhalers and antihypertensive therapy when the VP was in acute respiratory distress demonstrating a rigidness and lack of reflexivity to the simulation.

6.3.4 Negative Behaviours

Negative behaviours were those deemed not to be useful or detrimental for effective patient care.

Confusion, Panic and Pressure

Some student groups demonstrated signs of confusion and panic in response to the simulation. Observational data revealed students panicking when the VP was not responding to treatment or if the patient was acutely unwell or dying. The pressure experienced by students was amplified when alarms were sounding, when a prescription was not having the desired effect, when NICE guidelines were followed and found to be ineffective, or when students decided to fast-forward the scenario. Students will have only experienced the pressure of full responsibility for patient care in previous simulated activities or in classroom activities; the variety of psychological responses to this pressure (from improved teamwork, via experimentation to confusion and panic) demonstrates both differences in personality and professional aptitude. The fact the simulation brought out these behaviours which can be commented upon and challenged in a de-brief situation shows the value of this tool both as an educational and reflective intervention.

Pressure was not only mediated by technology, students alluded to a competitive pressure between themselves; students wanted to know why others knew things that they did not. Responses such as *'were you in the same lecture?'* showed a jealous attitude to natural variations in educational experience between individuals. Nursing students demonstrated this differently to others by acknowledging the discrepancies between their own placement activities and knowledge base.

"…we all got different placements so we know different things" [N004]

Role-reversal also created pressure as students had no prior experiences of how the other professional prioritised problems or dealt with patient care. The fact that members of this profession were also working with the team member added to this pressure in the initial stages of the simulation, but this soon passed as team members wither settled into their 'new' role or reverted to type.

Boredom and Irritation

One of the key factors in the original design specification of the simulation was the desire to make sure each profession has something to do, consequently facilitating learning with, from and about each other (169). The majority of participants did not express boredom at any time in the scenario, but those who did express irritation did so when they had nothing to do in the simulation, or when they perceived they had no contribution to make.

"…because at that stage I had no idea what the antibiotics [were] that was down on the form then…I didn't really have any more to do." [N004]

Impatience

The ability to constantly monitor the VP was viewed as positive by participants but often resulted in impatience. As the simulation models 72 hours in a patient journey, students could potentially spend the entirety of the 72 hours monitoring vital signs and adjusting treatment plans. Students certainly spent less than 72 hours with the patient, with the average length of time somewhere in the region of 30-60 minutes. Two features of the technology did contribute to an increased level of interaction with the technology: the vital signs monitor and an increased accuracy of vital sign reporting. The vital signs monitor (Figure 2.4), allowed participants to constantly monitor the patient and observe minute by minute changes in readings. In addition to this the increased accuracy of reporting (e.g. temperature and SpO_2 to two decimal points) increased the pressure experienced by students, and exacerbated their responsiveness to issues creating a culture of hyper-observation. This provided what participants referred to as the addictive aspect of the simulation. Participants often expressed concern when oxygen therapy seemed to be ineffective and then would increase the 'dose' beyond the recommended concentration of 28% for a patient in type II respiratory failure, causing respiratory arrest within thirty minutes of simulated time. When questioned on this behaviour, some participants described the expectation of an instantaneous result from treatment despite being briefed that the VP would respond in real time to any therapeutic intervention. Prensky and Sinek would argue that millennials (which covered the majority of student participants in the project) have grown up in a world dominated by digital technology and thus are used to instantaneous results from search engines such as google. This in turn fosters a lack of patience amongst this demographic (206). This cannot fully explain the behaviours observed in the scenario, as lecturer participants did not belong to the same millennial demographic and still demonstrated impatient behaviours. Whereas student participants tended to nervously wait for treatment to take effect, if lecturers felt the VP was not responding as they wished then they tended to try increasingly desperate and futile treatment strategies in order to gain a response. A possible explanation for this behaviour may be the wide variation in patient phenotype which means it is very difficult for inexperienced participants to anticipate the time required for a treatment to work. The very fact the VP can be monitored every second meant that participants treated the VP as an ‘intensive care’ patient when in practice they would monitor vital signs every 15, 30, 60 or 120 minutes. This made participants more ‘twitchy’ and increased the frequency with which they reviewed or altered any treatment, often to the deficit of patient care. Participants were briefed on the real-time nature of the VP response prior to engaging with the simulation. It appears that they did not fully realise that being able to constantly monitor the VP would have significant impact on the way in which they cared for the VP. Participants with greater confidence in their clinical reasoning, tended to exhibit more patience than others.

Subversive Behaviour

One student group provided a counterpoint to the argument that the simulation can improve students competence, by ‘killing’ their VP three times in a short period of time. This group was led by a student who fitted into the classical archetype of the ‘unconsciously incompetent’ student. This individual lacked the skills necessary to appropriately diagnose and treat the patient; however possessed the confidence and belief that he was more than capable of doing so. This individual demonstrated some highly dangerous behaviours for patient care by subverting the process and convincing others of his ability to manage the situation at the first attempt.

“Group with P020 in looking at nothing in particular, P020 pretending that they can read an X-ray and actively fooling other members of group, killed patient quickly.” [Observational data, pharmacy-nursing group]

The individual then compounded this with an excellent demonstration of hubris on the second and third attempts, where he failed to listen to other members of the healthcare team.

“P020 still not listening to nurses despite killing the patient twice.” [Observational data, pharmacy-nursing group]

This individual demonstrated practice levels below that expected of a final year student and this was highlighted in the de-brief and on an individual level following the simulation. This demonstrates the ability of the simulation to actively identify unconscious incompetent students. All the councils for healthcare professionals in the UK agree that students should not and must not be expected to work beyond their competency (71–73,270), therefore this simulation could function as a competency assessment for students both in terms of disease specific and communication skills. In addition to spotting the unconsciously incompetent it also reveals participants unwilling to challenge an unconsciously incompetent individual; other members of the group could have expressed stronger opinions to attenuate the individual's behaviour more quickly. This replicates earlier findings regarding simulation by Reeves and Van Schaik where doctors failed to be critical of nursing colleagues following simulated activities because *'they have to work with those people the next* day' (62). In turn, this affirms Dunning and Kruger's assertion that negative feedback is essential for behavioural change amongst the unconsciously incompetent; without being shown how to be competent then these individuals will carry on behaving in the same manner without cause for change (223).

It is important to note the behaviours of this individual were identified by an experienced practitioner observing group dynamic and individual behaviour in a ratio of 1:18 students. If the technology was developed in order to facilitate asynchronous communication via mlearning then this behaviour may be more difficult to elucidate. Assessment for clinical skill could be maintained however, group dynamic could be hindered by the lack of face-to-face interaction and individual occurrences of hubris would be difficult to identify. More research will be required in order to explore this challenge further.

Response to Failure

If participants 'failed' the simulation (e.g. if a death event occurred) the range of observed emotional response was broad. Some students were visibly upset demonstrating empathy and engagement with the avatar. Others became angry with the technology; this was especially seen if the group had made a decision to 'skip forward one hour' and then had no opportunity to correct mistakes they had not realised they had made.

"[patient dies after skipping one hour] Students visibly upset by this, "Can we not have another go?" "Did other people kill him?" There is some degree of anger that they didn't have the opportunity to observe his deterioration." [Observational data from MDT group]

Groups who failed the scenario were often keen to re-attempt it and correct their mistakes where necessary. This phenomenon has been seen previously in the gamification of education (146,222) and helps to facilitate one of McGaghie's key pillars of medical simulation, that of deliberate practise (107).   In the majority of cases where participants attempted the scenario for a second time, there was a marked improvement in the way in which they cared for the VP. This was manifested in increasingly appropriate treatment recommendations, a more cautious approach to monitoring or more directed information gathering:

"Let's try again. I do like this….What drugs would you give him? If cephalosporins caused that [anaphylaxis], what would you give him? It's just interesting to know what we would do." [D010]

These examples demonstrate the ability of the simulation to improve patient outcomes and transform students from consciously incompetent to consciously competent.

6.4 Stereotypical Behaviour of Student Participants

6.4.1 What is a Stereotype? Definitions and Explanations

Stereotyping was a phenomenon uncovered in phase 2 of the study. Some stereotypical behaviours were shared by all professional groups, whereas others were individual to each profession. Nursing students described themselves as strong patient advocates, medical students were inquisitive, pharmacy students were paralysed by ambiguity. In the results stereotyping was grouped into stereotypical behaviours and stereotypical educational experience. In the discussion I have found it more useful to discuss stereotypes in relation to each professional group followed by those which were common to all healthcare professionals.

The word stereotype is often associated with negative connotations, and as such it is important to note that no instances of one student group actively stereotyping another were recorded in the study; rather student chose to self-stereotype their own role. Stereotypes are strongly associated with the work of Katz and Braly (1933) on racial stereotypes. Cardwell (1996) defined stereotypes as "a fixed, over generalised belief about a particular group or class of people"(271). Stereotypes can be divided into explicit stereotypes which individuals are willing to verbalise and admit to others, or implicit stereotypes which exist in the unconscious state and which individuals have no control or awareness of. Stereotypes are associated with the Social Identity Theory proposed by Turner, Tajfel and colleagues (85); where individuals positively favour their 'in-group' above 'out-group' members. McGarty and colleagues (271) list three principles behind the formation of stereotypes:

1) Stereotypes are aids to understanding
2) Stereotypes are energy saving devices
3) Stereotypes are a shared group beliefs (about another group)

In short stereotypes are used by an individual about other groups to help them define that person, to save time and to assimilate themselves within their own group. They go on to state that a true definition of stereotypes must take into account that peoples' views become increasingly similar in the presence of mutual social influence within a group. As a result they define stereotypes as "An impression of groups held by anybody regardless of whether the accuracy of that belief is disputed."

Given such a broad definition it is unsurprising stereotypes were encountered in the study. Medicine, nursing, pharmacy and physiotherapy all share commonality as healthcare professions with a primary aim of working for the benefit of a patient; however the way in which they approach problems, their relative social status and perception from the general public differ. They all have their own professional sub-culture, with separate paradigms of good practice (86). Despite the increase in time devoted to interprofessional education over the last 10-15 years, students spend the majority of their undergraduate study in uniprofessional silos where tribalism and misconceptions of other professionals may occur.

It must be remembered that the somewhat contrived nature of a focus group may lead participants to perform unnaturally by taking on a role they think the researcher wants; or by performing as a stereotype or caricature of themselves (192).

Overt stereotyping of another profession was only recorded on one occasion in the study, when a physiotherapy lecturer spoke of their experience of pharmacists. This may be due to previous experience in practice where pharmacists have reinforced a negative stereotype of '*writing on drug charts with their green pens.*' This could be framed in terms of 'professional banter' as referred to by Baker *et al* (272). It is unlikely this participant would have been exposed to interprofessional education in their undergraduate study, and the tone of the conversation pointed to this belief being enshrined in past experience rather than pre-registration study.

The majority of stereotyping observed within the study was of a benign nature, participants were not prejudiced against each other; rather they behaved in manners which have frequently been described in the literature as characteristic of their profession. Pharmacy students avoided making decisions but were happy to advise on drug use (164); nurses observed patients regularly, took control of oxygen delivery but felt uncomfortable when asked to prescribe (215); medical students exhibited confidence, shared their knowledge with others, and were happy to lead on prescribing but overtly abnegated responsibility for drug related problems (166). Wackerhausen argues that in order to be recognised as a full member of a profession, a person has to acquire and behave according to its' cultural dimensions, and often these are acquired informally (86). These stereotypical behaviours form part of the cultural norms for each professional group and have been realised in the nascent professionals. Some behaviours were shared by all students whereas others were individual to each profession.

6.4.2 Stereotypical Behaviour

Stereotypical behaviour refers to students who acted in a manner which correlates with known personality traits of their profession. Students behaved in a stereotypical manner on a subconscious basis; actively denying behaving in this way in focus groups whereas observational data revealed many instances of stereotypical interaction in the simulation. This leads to the question, why are the students acting in this manner, and why are they not consciously aware of it? Stereotypical behaviour was often uniprofessional in nature, with participants often reverting back to their individual professional traits despite being asked to play the role of another professional group. This is defined as self-stereotyping or autostereotyping, which occurs when an individual adopts commonly held characterisations of a group into their behaviour (273). Self-stereotyping is a phenomenon commonly observed in low-ranking members of society, often employed as making the individual part of a wider whole, and thus a more powerful entity (273). It is unusual to see this amongst a powerful profession such as medicine, however one must remember students are the lowest ranking members of a profession, and thus medical student self-stereotyping occurs to integrate and ingratiate themselves to the medical profession itself.

All professional groups reverted to type if they had knowledge to share for the benefit of the patient. Patient-centred care was first advanced in the UK by the introduction of the Patient Charter by the Major Government in 1992 (41). Since then both the governing bodies of healthcare professions and the NHS itself have introduced policies and standards requesting healthcare professionals to make patients their first concern (71–73). It appears that students are adhering to their professional standards by placing patient care (even of a virtual patient) above their own education. Despite this commonality stereotypical behaviours were more frequently observed within professional boundaries, reflecting paradigms of practice within each profession.

6.4.3 Stereotypical Behaviour of Nurses and Nursing Students

Patients come first

Nursing students frequently articulated their role as a strong advocate on behalf of the patient. Patients came before any other priorities with acutely ill patients taking precedence. Nursing students thought this feature of their practice to be useful tool for interprofessional interactions, as it allowed them to explain their standpoint using ‘their patient’ as a key negotiating tool. Nursing students often saw themselves as the link between the patient and all other healthcare professionals as they would spend the greatest amount of time with their patient. This allows them to articulate the needs of the patient to others but also to possess the most pragmatic knowledge regarding the patients’ health, placing them in a position of power in interprofessional communication. Nursing students often commented upon the tasks they were asked to complete by other healthcare workers, notably doctors and medical students. If the task was unrelated to patient care or was not deemed a priority for the nurse they were more than happy to refuse or delay the execution of the task, using patient need as the reason for refusal. This fits in well with the theory that healthcare professionals are happy to question or challenge members of other professions rather than their own, as questioning direct authority may have a negative impact on the day to day tasks of being a healthcare worker (62,168,234,253,262).

Haptics, Observation and Humanistic Approach

Another stereotypical trait of nursing students to emerge from the study was their need to touch, observe and talk to patients in order to complete their assessments. This holistic approach was articulated as 'learned through experience in practice', for nursing students the physical observations of how a patient interacts with his environment were just as important as objective measures such as temperature and respiratory rate. As the simulation did not facilitate observation of breathing patterns, or degrees of breathlessness whilst speaking, there was a strong feeling from nursing students that the technology could be improved. Also due to the interface design, nurses could not view the patient and the vital signs at the same time (Figure 2.4), which was again cited as a difficulty in interacting with the technology.

Experience is the only form of learning

All nursing students expressed a strong preference for practical, experiential forms of learning above all other forms of education. They often used vignettes from past experiences to illustrate their points with respect to communication and technology. Experience was viewed as a both a powerful learning tool but also as a way to promote the profession to others.

Experience bred confidence and allowed students to behave in a calm and collected manner when the virtual patient was deteriorating. Students were strong advocates for their profession, and demonstrated some experience of being looked down upon by other professional groups; experience was cited as a method to combat this stereotypical impression amongst other groups

"…as a nurse with other healthcare professionals sometimes they don't respect that you know what you're talking about, that you've seen similar situations, that you've experienced it before…" [N006]

Nursing students did not refer to theoretical study at all, preferring to rely on their experiential learning. The stereotypical education of nursing students consists of 2300 hours of clinical experiential learning. Some participants acknowledged the diversity of experiences on placement as a limitation of their education. A student working in Accident and Emergency described how he had developed a good skill set with respect to stabilising acutely ill patients, but then would be unsure of how to manage a sub-acute ward based situation.

"…we all got different placements so we know different things" [N004]

This also limited nursing student ability to manage unfamiliar situations; frequently the paradigm of ward based training and previous simulation was articulated as *'we do the initial observations…the medical students, they've [doctors] diagnosed and then we've given the treatment as nurses'.* It has been compulsory for nursing students to obtain a degree since 2013, this was advocated as a way to increase independence and analytical skills amongst the profession, essential for isolated models of primary care working envisaged in the future (274). Nurse training in the UK currently follows a model of 50% theory with 50% practical experience. These findings suggest that students believe experiential learning to be of far greater value than classroom based learning. Further work in this area, alongside the views of practising nurses and nurse educators would help to explore this context further.

Reliance on others to lead/confirm

Nursing students did not only rely on past experience to formulate plans to deal with the simulation, they also demonstrated a dependence on other healthcare professionals both for reassurance and for when they believed themselves to be acting outside their competency. These events occurred despite there being little objective evidence for their necessity, suggesting a stereotypical lack of confidence amongst nursing students. For instance in one case the nurse deferred to the doctor and pharmacist despite being clearly the most knowledgeable in the group. This appears to be a 'learned behaviour', with nursing students feeling comfortable when they were working with other professions.

"in terms of like deciding to prescribe it was a collaborative thing but… I don't usually get involved in what drug to prescribe over another…that's not my decision. I sort of like left that to these guys [pharmacists]…" [N006]

This behaviour matches well to stereotypes of nurses portrayed in the media as 'doctors handmaidens' and a supportive profession of medicine (275). The domination of the nursing profession by medicine can be dated in western Civilization to the 1900s (276). This may provide some explanation for the fatalism of the nursing student in the following exchange:

"when you look at the bigger picture, you're just doing what you're told to do, technically. You [doctors] tell us what you want and we do it." [N010]

This remark appeared to be coloured by previous experience, suggesting that ward environments frequently run along these hierarchical lines. If so, this resignation may signify an adaptation of student expectation and behaviours to the reality of the situation they find themselves in outside of the university setting. The stereotypical role of the nurse as a 'doctors handmaiden' may lead to reduced job satisfaction and poor patient outcomes (277). This may lead to a poor self-concept and a negative self-presentation as nurses become an oppressed group (with the medical profession as the oppressors). Poor self-concept leads to low professional concept (278), which in turn increases the likelihood of individuals self-stereotyping with 'in-group' characteristics. Gordon *et al* speak of the heroic medical narrative as being particularly troublesome for the development of team intelligence in healthcare (168). The 'heroic medical narrative' is argued to socialise nurses to be deferential to doctors who are trained to give out orders and take total responsibility. Nurses often combine deferential behaviour whilst bemoaning that doctors believe *'they only change dressings'* (279).

It is clear that nurses and doctors must perceive each other as different but equally important to patient care (279). The advent of extended roles, educational programmes at degree, masters and doctoral level, and increased responsibility in terms of prescribing and diagnostics for specialist nurses (advanced practitioners) demonstrates that nurses in the 21st century cannot only act as 'doctors assistants'. Ten Hoeve *et al* acknowledge that nursing is not perceived as a scientific and professional career, with nurses being prized for their virtues rather than knowledge (275). The 6 C's for nursing developed by the NHS in 2016 encourage nurses to inculcate the values of care, compassion and courage into everything they do (243). Thus, it is somewhat concerning but maybe not surprising that nursing students feel that they still have to conform to a more traditional stereotypical role within simulation and their studies.

The final barrier to mistakes

Despite seeking reassurance and advice from others nursing students were very clear as to where their personal responsibility lay. Nursing students were particularly cautious when asked to be involved in the prescribing process as this was outside their perceived competency. Administration of medicines was not modelled in the simulation but nursing students commented on the risks to their professional registration posed by both prescribing and administration errors. Nurses reflected upon this and styled themselves as 'the last barrier to error before the patient', students described ways in which they reduced patient risk in this area such as reading through patient information leaflets before administering unfamiliar medication and checking patient allergy status. This behaviour was both reassuring from a patient perspective but also provided an insight into how nurses interact with other healthcare professionals when errors or near misses are discovered. This trait was shared in common with pharmacy students who frequently behaved in a risk averse manner when dealing with prescribing decisions.

6.4.4 Pharmacist and Pharmacy Student Stereotypical Behaviour

Pharmacy students were observed in uniprofessional and multi-disciplinary focus groups, allowing for a broad range of views to be obtained and behaviours to be observed. Six behaviours which could be classed as stereotypical of pharmacists were observed amongst students: slow decision making, looking up answers before giving them, perceived limitations of competence, isolationism, avoidance of direct questions or challenges, and deference to other healthcare professionals.

Agonising over unimportant decisions

Both sub-groups of the pharmacy-only group approached the simulation in a collaborative manner, with no clear leaders emerging. Students spent a long time discussing and making decisions regarding the care of their patient, e.g. students would argue about the dosing schedule or length of treatment course prior to prescribing, which did not occur in multi-disciplinary groups. This slow decision making process was augmented by the frequent use of resources such as the BNF or NICE guidance in order to 'do the right thing' for the patient. Qualified pharmacists modelled this behaviour by frequent recourse to the BNF, although they tended to use the resource more selectively and efficiently. This mirrors the findings of Rosenthal et al (164) who state that pharmacists are often paralysed by the ambiguity of patient facing decisions, because their undergraduate study is heavily influenced by science. The scientific positivist norms of true and false rarely apply in patient-facing situations, and because of this pharmacists have great difficulty giving an answer until they have all the facts available to make a decision. Gregory and Austin expanded on these theories, observing that pharmacists had co-opted their role in the healthcare team as an educator rather than a decision maker, with some pharmacists going to great lengths to avoid decision making (229). Rosenthal later associated pharmacists with the personality trait of conscientiousness (280) , pharmacists do not like to even countenance giving incorrect information thus reinforcing the need to check and double-check answers before passing them on to others. Another study in the UK demonstrated that a majority of pharmacists were naturally cautious and worried about the decisions they made (216). This behaviour was modelled when pharmacy students were interacting with the simulation:

"It was interesting watching you [pharmacy only group] make decisions because you took a long time over everything and you were thinking about, 'Well what antibiotic can I give? What dose do I give? How do I give it?' …and you were very methodical. Which is good and it's probably how you've been taught to be but if you had a guy who was dying in front of you it might not have been [laughs]." [Researcher de-brief]

Despite increasing clinical contact, problem solving and knowledge application exercises in the MPharm, the simulated case demonstrated that pharmacy students still struggle in the face of ambiguity. This may be due to inherent personality types recruited to the profession, the attractiveness of the profession to school leavers or behaviour inculcated into student by the MPharm programme.

Self-imposed limitations on competency

Pharmacy students tempered their slow decision making process by being able to theorise and problem solve in situations where they did not have the knowledge to answer immediately.

For instance, when presented with incomplete data regarding the choice of antibiotic, salient choices were made in the majority of cases. These decisions may have taken some time to have been formed but were always grounded in a reasonable reference source. Students expressed their competency in terms of *'We're not doctors, but we know where to look for an answer.'* Despite this pharmacy students would seek reassurance from the facilitator pointing to their discomfort with taking responsibility for prescribing decisions. Numerous studies have reported on pharmacist responses to increasing responsibility. Rosenthal and colleagues first noticed pharmacists in Canada were reluctant to expand their services beyond the traditional dispensing role (164), others have shown pharmacists to dislike taking responsibility for patient outcomes (167,259), and lacking self-confidence whilst prescribing (245). Abuzour and colleagues especially note that hospital pharmacists are reluctant to use their independent prescribing qualification in the UK to initiate prescriptions, and are much happier and confident when adjusting doses of previously prescribed drugs.

Isolationism

Further stereotypical behaviours were observed with regard to isolationism and avoidance of conflict amongst pharmacy students. Students actively articulated their opinion of a stereotypically pharmacist trait *'of not talking to anybody'.* Whilst not modelling this behaviour directly in the study, observational data did reveal avoidance of conflict from pharmacy students. One of the strategies used by pharmacy students to avoid conflict included ignoring direct questions from a colleague especially when unsure of the answer. Gregory *et al* noted pharmacists deferring to other professionals to avoid decision making and potential conflicts (229).

Deference (avoidance of final responsibility)

Pharmacy students were found to be deferent in a number of scenarios, most notably regarding prescribing decisions when collaborating with medical students. Pharmacy students were unwilling to make a decision but happy to advise on the appropriate treatment and dosing schedule for a patient. This perhaps related to a perceived lack of confidence in diagnostic skills, however this individual behaviour could be suggestive of a more widespread character trait amongst pharmacists, which is being passed on to students via educational or experiential occurrences. Gilligan et al (207) cite the 'hidden curriculum' as a powerful factor in how students perceive lessons and form their professional traits. The 'hidden curriculum' involves lessons which are learned but not taught and can involve role models transmitting unintended messages verbally or non-verbally. Pharmacy students in the UK must leave University with a working knowledge of the sale and supply of medicines, including the ability to provide accurate written or oral information appropriate to the needs of patients, the public or other healthcare professionals (73). One of the common paradigms of simulation in pharmacy education involves 'the prescription query' where a pharmacist will contact a prescriber to amend a prescription to make it safer for a patient, in other words to reduce risk. This interaction may encourage students to act in a stereotypical risk averse and deferent manner. It could be viewed as subliminally conveying the message that pharmacists query prescriptions rather than write them. Gregory et al (229) note that pharmacists co-opted their role as an 'educator rather than a decision maker' a clear example of this behaviour was noted in the results:

D003 [*Directed to P002] 'Want to give him steroids?'*

P002 *'It's up to you'. Makes doctor make the decision, but provides advice on which steroid to prescribe and dosing schedule.*

Pharmacy and nursing students were deferent in differing ways. Nursing students conformed to the stereotypes of caring for patients, which allowed them to take power in the situation if they felt it appropriate to do so. However they also conformed to the stereotype of nursing being less competent than the medical profession (266) by deferring to others unnecessarily in some cases. Pharmacists on the other hand actively deferred responsibility to medical students when prescribing decisions had to be made, but they took the decisions collaboratively with nurses if no doctor was present. This suggests that they feel intellectually equal to nurses but inferior to doctors, but also as a whole would rather the doctor take responsibility for patient facing decisions due to their risk averse nature (164,166,167,216,229,245). Deference may well have been a natural characteristic of the students who volunteered for the study, or it could have been learned in practice via the hidden curriculum. If qualified pharmacists and nurses they have been socialised into deference, they enable authoritarian behaviour from other members of the healthcare team which may in turn jeopardise safety (168). As qualified practitioners serve as role models, they may well be sending undesirable messages about hierarchy and communication to students. This can only be remedied by training for qualified staff to redefine traditional views of authoritarian behaviour.

6.4.4 Stereotypical Behaviour of Medical Students

Abnegation in areas of weakness

Medical students tended not to defer to others' knowledge in most areas of the simulation, however if they regarded another member of the team as 'an expert', there was evidence of the medical students abnegating responsibility for that particular aspect of care. A particular area of weakness was identified regarding drug therapy, when asked to play the role of a pharmacist in the simulation a medical student responded *'good luck with that'.* Later in the simulation the same student threw the BNF along the table at a pharmacy student whilst they were struggling to look for a drug monograph. In phase 1 medical students asked pharmacy students directly which drug should be prescribed and at what dose. Active abnegation is linked to a feeling of incompetency within medical students, expressed in a different manner to the other healthcare professionals. Austin, Gregory and Martin noted in their study of pharmacists who retrained as physicians (166), that medics tend to have increased levels of confidence and have to put on the 'cloak of competence', this translates as knowledgeable behaviour in the absence of evidence or acting upon incomplete information. Abnegation seems to occur in medical students when this veneer is threatened, the medical student code of conduct states they have to accept that they cannot be responsible for everything, and thus if they can project that responsibility onto someone they view as more qualified in that area they are happy to do so. Doctors are often stereotyped positively by others with descriptors such as knowledgeable, responsible, trustworthy, logical being attributed to the profession (230). Negative descriptors such as arrogance, and domineering personalities have been linked to traits such as power, authority, independence and self-confidence (165)(260). It is reasonable to assume that medical students may feel the need to incorporate these characteristics into their personality as they are the least powerful members of the medical profession, a recent study noticed that pre-clinical 1st and 2nd year medical students identified more with stereotypes of doctors than students (230). Wilson and colleagues furthered these ideas by suggesting that as medical students cannot make a positive contribution to patient care, they ingratiate themselves to the profession by adopting the characteristics of senior colleagues (281).

Authoritarian leadership & Hubris

Medical stereotypes occurred both within the professional group and outside of it. Other healthcare students who were asked to role play the doctor in the scenario made many attempts at authoritarian leadership. This ranged from stern non-verbal communication to the formation of stereotypical patriarchal doctor-nurse relationships.

When other professional groups in particular were asked to role play the doctor, some degree of hubris was modelled, suggesting that students have strong stereotypes of how doctors behave. When medical students were present in the simulation however, these behaviours were not modelled by the medical student themselves or the other students in the simulation. These stereotypes had been reinforced by the previous experience of some nurses in health care settings, but may also relate to stereotypical doctor nurse relationships portrayed in the media (275,281). Medical students acknowledged that their own profession was hierarchical in nature, with consultants holding power over their juniors. Hubris had been observed in experiential placements when medical students 'with a lack of life experience' felt they could order other healthcare students or professionals around.

"They've not worked and they've not been in the real world. They don't really understand. From their background, they think that everyone is below them. On the ward, they're like, 'We're the best. We want to follow a consultant or a surgeon.'" [D010]

Whilst hubris has been recognised as a source of poor healthcare outcomes (1), stereotypical doctor-nurse conflict narratives portrayed in the media often result in good outcomes for the fictional patient; this paradigm is not reflected in the real world where patient care has often been seen to suffer where there are conflicts in the healthcare team (267,282).

Toxic hierarchies are a natural consequence of socialisation which causes one profession to become deferent to another (cf nursing and medical professions since 1900)(276). The general public are generally socialised to view communication as a transaction between two people which leads to the view that leadership should be a directive top-down relationship (168). Patriarchal behaviours and hubris modelled by students role playing doctors in the simulation demonstrate that students have either witnessed these behaviours and adopted them due to the 'hidden curriculum' (207), or believe they should be perpetuated. Edmondson believes that organisations need to adopt a culture of psychological safety where hierarchy should be redefined, human fallibility must be recognised and all employees must feel comfortable to express their opinions without fear of reprisal (283).

Inquisitiveness

One positive stereotypical behaviour noted of medical students was their inquisitiveness. They were interested in finding solutions to problems posed by the scenario and happy to take the lead for their own learning, actively encouraging others to follow them in their mission. The best example of this behaviour was recorded serendipitously when the researcher had to leave the room during de-brief, the medical student actively reset the simulation and attempted to rerun the scenario reviewing decisions which had been made to the detriment of patient care. Inquisitiveness or thirst for knowledge has long been recognised as a desirable characteristic of an ideal medical student (264). Austin and Gregory (166) demonstrate that medical school has an inherent competitiveness where students will not share information with each other, which would inherently foster inquisitiveness amongst their students.

(Over) shares knowledge

In a similar manner to inquisitiveness medical students were also happy to demonstrate the wealth of their knowledge in the areas of physiology, pathology and diagnostics. Medical schools possess higher entry requirements than other schools and as such it can be assumed that the typical medical student would have above average intelligence. Knowledge was observed to be a method students used to lead others in the scenario, medical students demonstrated their breadth of knowledge frequently only deferring to other in specific areas such as pharmacology. Even when asked to play the role of the nurse medics used their knowledge for the benefit of the patient, and tended to lead the activities of others. Lipworth and colleagues report that members of the medical profession are concerned about respect for their knowledge base, as much if not more than their status as a high powered profession, as a result they like to have their skills appreciated by other associates (234).

6.4.5 Shared Stereotypical Behaviours – students like their stereotypical roles

Students appeared to enjoy playing their pre-defined roles in the simulation. Simulation especially interprofessional simulation can be viewed as an 'unsafe' environment educationally, where students are exposed to new people who may not share their professional worldview. They may also feel as though they have to prove their worth to the other practitioners. This phenomenon may explain why students appear to self-stereotype themselves in the simulation while actively avoiding stereotypes of other professions if they are present. Self-stereotyping is usually associated with groups who are perceived as low-status (273,284), nurses are often identified as low-status healthcare professionals (268), pharmacists often feel inferior to doctors (166) whereas doctors are considered to have high status and are thus less likely to self-stereotype. Latrofa and colleagues suggest that low-status members of an in-group often show a higher propensity to self-stereotype. This is augmented by the work by Wilson *et al* which suggests that medical students often conform to the behaviours of their supervisors in order to integrate themselves into a community of practice (281,284). The self-stereotype could be compared to a 'comfortable coat' or home where the student feels safe in their understanding of the wider world. The question then becomes who gives the student the coat or home? Many stereotypes in healthcare are often formed prior to commencement of vocational training, the media often portrays negative stereotypical views of healthcare where nurses may be viewed as 'handmaidens of doctors', or conversely doctors as incompetents saved by nurses (267,281,282,285). Certainly non-medical student impressions of medical practitioners conformed to these norms of media output. Self-stereotypical behaviours exhibited in this simulation rely on previous profession-specific training students have received both explicitly via teaching experiences and implicitly via the hidden curriculum (cf Figure 5.3). Students have a view of their role in the healthcare team and are more comfortable and more likely to collaborate from that position of comfort. Student education is naturally governed by the central councils who release standards for pre-registration training. These tend to be competency focused thus each professional group will naturally have areas of expertise, and characteristics considered essential for practice. Medical students are experts in anatomy, physiology and diagnostics; nursing students will have been trained in a humanistic approach to healthcare and pharmacists use a therapeutic narrative with patients focusing on drug therapy and pharmaceutical care (212).

The simulation was designed in order to give each profession something to do. Students could ask questions of the patient, order tests, perform diagnostic examinations, record vital signs and prescribe drugs and oxygen. Educationally the simulation was left entirely freeform with students having the ability to do as they pleased. Students verbally appreciated this aspect of the simulation however observation revealed they fell into stereotypical roles and behaviours with doctors taking overall control, nurses observing the patient for changes and commenting upon oxygen and pharmacists making recommendations based on their drug specific knowledge. This leads to the conclusion that the simulation itself gives the students stereotypical roles to perform and as such may lead to stereotype formation.

A wide review of the literature regarding simulation and IPE reveals a majority of simulations being of an acute emergency nature. These situations naturally require clear, defined roles and responsibilities in order to achieve a satisfactory outcome. It is possible that all multiprofessional simulations stereotype learner roles, and as a consequence they may reinforce stereotypes amongst students (82). In 2012, Reeves and Van Schaik sounded words of caution for those who thought simulation would be the ideal way to deliver IPE (62). This study supports their assertion, but students still report that they had a positive learning experience which aided their understanding of each others' practice.

Stereotyping has always been thought of as something to avoid in IPE, however many of the stereotypical behaviours portrayed by students in the simulation were positive: nurses demonstrated advocacy for patients, doctors were inquisitive and calm, pharmacists were scientific experts. To further Kuper and Whitehead's points regarding stereotype formation in IPE (82), the results demonstrate that in fact stereotyping may be a valuable method of non-verbal communication in undergraduate IPE simulation. Student self-stereotyping allows them to merge parts of their self-concept with the wider profession, but also allows a student and those of other professions to define his or her role in the simulation quickly and efficiently. These sub-conscious behaviours are likely to have been learned as part of the 'hidden curriculum' rather than being explicitly taught, being learned from role models and non-verbal communication with faculty members. As a simulation often assigns roles to students based on their professional background, all simulation runs the risk of stereotype formation. It is of interest that students in the study fell in stereotypical roles much more quickly if they triggered an acute event in the care of their patient; the majority of previous work in simulation has concentrated on acute scenarios, thus increasing the chances of self-stereotypes occurring. The acuity of the simulation seems to act as a trigger for students to adopt roles which they are comfortable with; clearly acute situations require good communication and clear lines of responsibility. It is reassuring to see that this simulation facilitates the more nebulous manner in which teams form in the sub-acute setting but can also model the delineated model of working necessary in acute situations such as surgery.

Self-stereotypes are useful in undergraduate interprofessional education as they allow students to feel comfortable with others and to portray the relative benefits of their profession. With the expansion of nurse and pharmacist roles into areas traditionally the domain of the doctor, simulation for IPE must be used with caution. Stereotypical roles and behaviours are useful for undergraduate IPE, but they may be perpetuated in a workplace which has moved beyond traditional paradigms of practice.   Outdated attitudes could certainly harm collaborative practice, and further research into the use of simulation for IPE at post graduate level is warranted. The results suggest postgraduate simulations for IPE should be designed carefully to avoid the assignment of stereotypical roles to professions with a focus on how to share care and collaborate effectively with the different skills contained within each profession.

Complements as a means of team building

Stereotypical behaviours of other professions were valued highly by the teams as a whole. Participants would often compliment (or stroke) each other on their knowledge in certain subject areas, or their calmness in emergency situations. This behaviour was often observed post-simulation, and seen as a useful method of team building; this strengthens the argument that IPE is useful when there is something to *learn from* the other healthcare professionals.

6.4.6 Dissonance between Verbal Responses and Non-Verbal Behaviours

Students were well aware of the need to avoid stereotyping in IPE, but yet behaved in stereotypical ways and assigned stereotypical jobs to themselves and others. This points to a superficial agreement with the key objectives of IPE, students vocalise their belief in them but often do not behave in a manner commensurate with those aims. The very fact the lead researcher is both a pharmacist and a strong advocate of IPE may have influenced how students acted in the simulation and responded in focus groups. Students may well have felt uncomfortable expressing negative opinions of others both in front of myself and each other. This possibly explains the more pointed comments regarding other professions from the pharmacy-only group. Another reason for this may bee hidden curriculum where students model behaviours based upon influences from colleagues and lecturers. At this particular institution medical representation on the IPE sub-committee is provided by non-clinical staff, which could purvey the message to medical students that IPE is not important. This corresponds to work by others who have demonstrated medical students losing humanistic approaches to patient care in favour of empirical, scientific and curative approaches (281), and doctors quoting *'nobody ever progressed by being nice to patients'* (264). The fact interprofessional education at Keele is mostly assessed in a formative manner rather than comprising a summative, integral part of each course, again fixes the idea that IPE is unimportant in students' minds. Students were often more critical of IPE when interviewed as a single profession, suggesting genuine thoughts may be tempered or not shared at all with other professional groups. This suggests IPE may be viewed as a 'politically correct' form of education, where students feel pressured to verbally agree with the concept despite their private reservations.

6.5 Summary

During the study, participants demonstrated positive collaborative behaviours commensurate with the CAIPE definition of IPE *"where two or more professions come together to learn with, from and about each other."* It was clear that participants valued having each others' expertise on hand during the simulation, and they actively acknowledged that this improved patient care. Using Berne's model of transactional analysis it was positive to note that there were no recorded examples of crossed communication in the study. Politeness strategies were more frequently used amongst student cohorts with nursing an pharmacy student often deferring final responsibility to a medical student if they were present. This suggests an additional layer of hierarchy is added to the simulation when medical students are present, similar to the ones reported previously by Mandy *et al* (85). Students had observed toxic hierarchies during previous experiential learning, however they did not model these behaviours during the simulation.

A mix of positive, negative, leadership and followership behaviours were demonstrated by students in the simulation. This suggests the simulation may be used in combination with experienced observers to encourage students to reflect on the important behaviours necessary to develop team intelligence in practice.

No limitation was placed on how students interacted with the simulation, however students naturally enjoyed and felt most comfortable playing the role of their qualified equivalent. Even when asked to play a different professional role students quickly reverted to type and demonstrated behaviours which could be considered to be stereotypical of their own profession. This finding is somewhat unsurprising given the lead researcher designed the simulation wanting to ensure 'that every professional group had a role to play'. The fact that students were found to self-stereotype is not a worrying finding at undergraduate level; and could in some cases be perceived as reassuring as students are taking on the mantle of their profession. They certainly provided students with a comfortable place to work from when the acuity of the simulation increased. This in turn facilitated more effective communication, adoption of leadership and followership roles as appropriate based on the task at hand. It would be of more concern if similar findings were found in practising professionals who should have had greater exposure to expanded roles of professions such as nursing and pharmacy. The design of future interprofessional simulation should acknowledge to potential influence of hierarchy between the professions involved in the event alongside careful consideration of the 'role' each profession is expected to play.

CHAPTER 7 – FINAL SUMMARY AND CONCLUSIONS

7.1 Summary

Einstein stated 'knowledge is experience, everything else is just information'. He did not define what constitutes as experience, and certainly would not appreciate being the first recipient of the surgeon's knife. Since time immemorial healthcare students have been immersed into observational real world experience. As time passes the norm is that they take on more responsibility, with remote supervision until they are deemed competent to practise on their own.

This simulation adds another dimension to how a student 'learns experience', the flexibility of mobile technology allows students to learn the consequences of their actions without causing patient harm. Paradigm learning experiences may be manipulated by educators at the flick of a switch, allowing students to learn whenever and wherever they are. This has proven to be an effective teaching and learning methodology, and may be used in future to augment the value of experiential teaching and experience.

The qualitative nature of this study explored how students engaged with technology and each other during an IPE intervention. The observational and focus group design also revealed any underlying attitudes and behaviours students possess and propose solutions based on the outcomes.

This study in combination with the literature review has revealed multiple influences affecting the behaviours of healthcare undergraduates in IPE (Figure 7.1). Eight factors in total have been identified of which only two (what am I being asked to do? And, what relationship does this have to future practice?) can be directly affected by an IPE intervention.

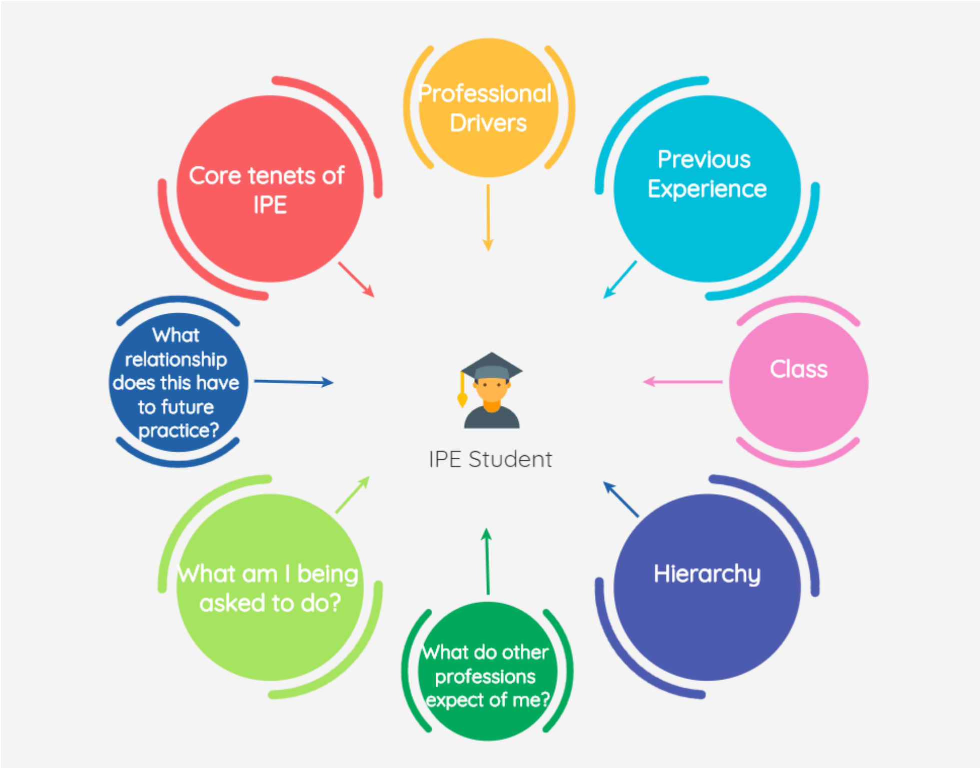


Figure 7.1 Psychological influences affecting the IPE student

The other influencing factors may relate to an individual or to a professional group as a whole. For instance previous experience may relate to previous experiential learning activities undertaken on an undergraduate course or relate to paradigm experiences with healthcare professionals prior to starting a course. These experiences may be positive or negative and can be challenged or reinforced by an interprofessional intervention. Individuals have little control over their socio-economic background, however this may influence the development of power relationships both within and without a profession, a combination of high socioeconomic class and a powerful profession such as medicine is likely to increase the power and social distance between this individual and an individual of low socio economic class in a less powerful profession such as nursing. This in turn may increase the chances of negative politeness or off the record strategies being employed in face-threatening actions such as prescription queries (253).

Professional drivers refer to the evolution of one's own profession in the context of modern multi-disciplinary healthcare. For instance the increasing focus on devolving prescribing rights to newly qualified nurses (232), will influence an individual to behave in a way which is commensurate with those competencies. Paying particular respect to IPE this may involve individuals modelling behaviours such as healthcare leadership or paying particular focus to technical competencies such as pharmacological review and therapeutic focus. Not every member of a multi-disciplinary team can be a leader, so the influence of one's own profession may lead to self-stereotyping. Particular attention should be paid to the inculcation of followership behaviours in undergraduate healthcare students. Encouraging students to inquire, advocate and assert where necessary may reduce the influence of hierarchy on IPE and ultimately the healthcare process (168,236).

Another major influence on behaviour is the question 'What do other professions expect of me?' Other professionals may carry outdated views or have past paradigm experiences of one's own profession which may unduly influence opinion. One of the key outcomes of an IPE intervention is to challenge and prevent the formation of negative stereotypes of *other professional groups*. In 2012, at the beginning of this project, Scott Reeves sounded a note of caution with respect to simulation in IPE, stating simulation is not a panacea for IPE (62). Simulation often gives participants established, stereotypical roles, which could in turn perpetuate negative stereotypes. This study required students to perform some stereotypical tasks, but gave no instruction or limitation on how teams should allocate work. Despite this freedom, students and lecturers alike fell into their comfortable roles. Even if the simulation asked participants to play a non-stereotypical role, students ignored this instruction and returned to familiar models of care.

This behaviour is likely to have been learned deliberately and intuitively via the hidden curriculum (207), one IPE intervention is unlikely to change three to five years of professional conditioning and ingratiation to one's own profession (86). In the aviation industry culture change was mediated by the introduction of Crew Resource Management (CRM). Gordon *et al* articulated that CRM was successful because a combined approach involving cultural change amongst qualified pilots, constant refresher training for workplace staff, cultural change, and adaptation of entry qualification and characteristics for trainees was implemented alongside pre-qualification training (168). Even with this multi-faceted approach it still took between twenty and thirty years to effect culture change in the industry. Thus IPE alone cannot be used to prevent stereotype formation in undergraduate students. Our study appears to augment Reeves and Van Schaik's theory that 'simulation is not a panacea for IPE' (62). Designing an interprofessional simulation requires careful consideration of the roles exoected from participants in order for them to avoid stereotypical behaviours.

Hierarchy clearly has a role to play in the development of professional behaviours in students. When hierarchy is introduced to IPE, communication and collaboration has been found to deteriorate (81). Student participants acknowledged medicine as the profession with the most hierarchical structure, however in NHS hospitals both nursing and pharmacy also have some degree of hierarchy. Students enter their profession having to be respectful of the hierarchy in place within it; nurses answer to ward managers, F1s to their consultants and registrars, pharmacists to their seniors and superintendents. The requirement of references and positive reports from senior staff make it difficult for newly qualified professionals or students to challenge authority within their profession; in addition to this they may well adopt attitudes and behaviours seen as positive within their profession's remit. These behaviours may not be useful for interprofessional collaboration and in fact prove to be detrimental to future team work.

The final influence on behaviour observed in the study are the core tenets of how to behave in an interprofessional education event. Intended learning objectives in IPE often focus on teamwork, collaboration, communication and challenging authority and stereotypes. Students and professional participants (62) alike appear to act in a manner which is non-offensive to other professional groups. When students are asked about how they interacted in the scenario suggestions such as: being a good listener, being nice, professional communication, act as a team player were mentioned frequently. Anderson, Tassone and others note *that 'IPE is not about being nice to each other, it is about communicating effectively in order to improve patient care'* (236,286). Experience from the aviation industry shows that Crew Resource Management (CRM) was originally dismissed by some pilots as *'charm school'* (168). Therefore it is important that patient safety messages and the importance of clear communication are reinforced by facilitators when delivering any IPE intervention.

Student observation revealed less polite methods of communication and the modelling of stereotypical relationships from practice. This suggests a disconnect between what students say and how they act. It appears that they feel the need to articulate IPE as a team working exercise where all participants should be respectful to each other; alongside an internal disagreement with some of the overarching aspirational aims of IPE. Student appear to realise, quite rightly that the need to work effectively in a crisis outweighs any need to be polite.

In summary, real-time interprofessional clinical simulation appears to be an effective tool which aids students to learn *with* and *from* each other. In our observed simulations learning *about* each other was facilitated via the hidden curriculum rather than any direct learning objective. The hidden curriculum is influenced by six external factors (Figure 7.1) which cannot be altered by the simulation alone. Careful design of future simulations of a similar nature must take into account and challenge any previous learning influenced by the hidden curriculum. An awareness of the 'home domains' of care and education (Figure 5.3) will provide a starting point in the planning of any interprofessional intervention. Providing learners with the opportunity to view where their profession lies educationally and with respect to the care of the patient will enable them to better understand not only themselves but also other viewpoints regarding care.

7.2 Limitations

This study was conducted with a small sample size of students from one UK University. Further work will be needed to see if the results are generalizable to the wider UK student population. Further professions such as undergraduate physiotherapists and occupational therapists would have added to the team dynamic, and made the simulation more authentic to current healthcare in the UK.

A truly ethnographic design would have been hard to achieve in a study such as ours, as the students were not working in their normal environments. The independent observer used in phase 1 should have brought no inherent bias to the study, however as we have discussed at length previous life experience may have had some influence over their observations.

It is acknowledged that as the observer in phase 2, my experience as a pharmacist may have influenced the interpretation of the communication, transactions and events during the simulation. This experience however, may have allowed me to detect and understand the significance of any nuances of communication as they unfolded.

In addition to the above the fact the lead researcher was a lecturer on the undergraduate MPharm and the lead for stage 2 interprofessional education across the Faculty of Medicine and Health Sciences may have influenced student behaviour and communication in the simulation and focus groups. Students may have felt it was socially unacceptable to criticise IPE in front of me, this may explain some of the dissonance between verbal and non-verbal responses in the study.

Participants did not engage with the simulation over 72 hours, therefore they were not exposed to a true real-time simulation. Behaviours observed in this study such as hyper-observation and stereotyping may not present themselves, if participants were exposed to a 72 hour simulation.

Focus groups were audio recorded, and simulations were observed with notes being taken 'in the moment'. If the simulations and focus groups had been video recorded, they could have been reviewed at a later date by a second independent observer. Video recording would also have allowed other techniques such as conversation analysis to be used in the write-up. These may have revealed further behaviours and data as yet uncovered by this study. Conversely if video analysis had been used as a core aspect of the study this may have changed or limited the volunteer population due to concerns over privacy.

7.3 Conclusions

The post positivist design of the study adds to the available information on how interprofessional relationships are formed within interprofessional education at undergraduate level.

Real-time virtual patient simulations are both a feasible and effective method of delivering interprofessional education at undergraduate level. Students demonstrate emotional engagement with virtual patients and enjoy the face to face aspect of learning from with and about each other. Students are sceptical about an entirely mobile version of this simulation as they regard asynchronous communication via messaging services as non-authentic.

The real-time nature and open interface of the programme forced students to be quick with clinical reasoning and decisive with respect to prescribing decisions.

This study takes healthcare simulation beyond acute emergencies into the sub-acute setting of the ward environment. This has filled a research gap into how students behave and learn in sub-acute simulations. Students were found to hyper-observe the VP to the detriment of patient care. This suggests they are modelling useful behaviours they have learned in previous acute simulations and applying them inappropriately in a sub-acute environment.

The simulation was successful in facilitating students learning with and from each other; students learned about each other by observing and listening to each other within the simulation. This passive process is likely to be mediated by external influences on student behaviour which have been learned and adapted to previous experience, in-course teaching or the hidden curriculum.

Students actively agreed with the aims of interprofessional education; but were found to disagree or model negative traits of other professional groups in observational study. This points to a polite, 'politically correct' agreement with the aims of IPE alongside epistemological disagreement with its objectives.

Interprofessional education is often non-authentic as it does not model the hierarchical environment students will be exposed to upon qualification in the UK. Participants in our study proposed that IPE helps professional groups to communicate and understand each other better, but does not necessarily help individuals to deal with hierarchical pressure. As a result IPE cannot be regarded as a standalone tool to prevent serious untoward events in healthcare as it does not have an impact on challenging hierarchical relationships within in single profession.

Simulation is inherently stereotypical if educators ask students to perform stereotypical roles. Students still self-stereotype even when asked to perform non-traditional roles. We argue that this behaviour is not detrimental in itself at undergraduate level as the students are modelling behaviours commensurate with their profession in order to convey a message of competency to other students. The stereotypical behaviour portrayed by students in this study may be of concern if carried forward into future practice, where non-medical professionals practise in advanced non-traditional roles.

The simulation highlighted what Dunning and Kruger (223) would term 'unconsciously incompetent' students. It is proposed that similar simulations may be used to identify these students; and appropriate de-briefing be delivered by educators to highlight student incompetence and help to move a student to the consciously incompetent level of the model.

Pharmacy students were found to use negative politeness strategies when interacting with medical students in the simulation. This behaviour may reinforce the traditional power differential between the two professions.

Nursing students were found to use ‘off the record’ politeness strategies more frequently than other professional groups. Focus group responses suggest this was due to perceived limitations in competency and educational deficiencies.

Medical students actively abnegate responsibility for work streams in which they feel deficient. This appears to be a learned behaviour from their studies suggesting they are already establishing their position as the leader of the healthcare team in undergraduate healthcare simulations.

7.4 Recommendations

Further research is required into the transferability of real-time virtual patient simulation to a fully mobile, asynchronous platform. This should focus on the interactions and authenticity of communication between healthcare students; and the ability of asynchronous technology to detect unconsciously incompetent students and make them aware of their deficiencies.

Further sub-acute simulations should be developed and evaluated for undergraduate education. It would be of interest to note if the findings regarding hyper-observation and stereotyping found in our study apply to larger cohorts and different settings.

Future interprofessional simulations need to be carefully designed paying particular attention to how students learn about each other. In addition to this students of the healthcare professions should gain an awareness of their stereotypical tendencies and the relative strengths of other professional groups. It may be useful to increase student awareness of the politeness theory developed by Brown and Levinson, and for students to use positive politeness strategies where possible in interactions with other healthcare professionals.

It would be of interest to conduct a similar study in more depth with post-registration healthcare professionals. This would allow further exploration to see if the stereotypical behaviours revealed in this study are perpetuated in the working environment.

This proof of concept study used a constructivist paradigm of research to develop appropriate methods and quantify what constituted knowledge. Independent observation of a small cohort suggested that power dynamics were present amongst a group of medical, pharmacy and nursing students. In future a study of student behaviour using the socio-critical paradigm may be warranted to empower the less powerful groups.

. Interprofessional education cannot be used as the only method to improve patient safety in the NHS Future untoward events may be prevented by improving communication across professional boundaries,; the breakdown of hierarchical structures which govern healthcare and adoption of working practises which encourage interprofessional collaboration and cross-monitoring. Until a culture of psychological safety is created in which staff feel safe in speaking up regarding poor practice; there will always be a risk of untoward events escalating. The NHS rarely speaks of team intelligence as a concept, however if the aviation industry has remedied a culture of toxic hierarchy, there is no reason this cannot be achieved in the NHS. Time, money, and effort are all required in order to re-train staff and to continuously reinforce new patterns of working in order to create a new working culture.

Undergraduate interprofessional education has the potential to create newly qualified practitioners who appreciate the value of other healthcare professionals. We encourage educators in continue to innovate in and advocate for IPE; whilst acknowledging the need for continuous post-graduate training in team intelligence, communication and ‘secure’ leadership models. This will produce experienced collaborative healthcare professionals who can both lead and follow in teams and will act as positive role models for the professionals of the future.

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Appendices

Appendix 1 - Ethical Approval

Ref: ERP2308

23rd November 2016

Jonathan Berry
School of Pharmacy/ISTM
Keele University

Dear Jonathan,

The Patient Tamagotchi, Phase 1 - Using Augmented Reality to facilitate Interprofessional Education

Thank you for submitting your revised application for review. I am pleased to inform you that your application has been approved by the Ethics Review Panel. The following documents have been reviewed and approved by the panel as follows:

Document(s)	Version Number	Date
Invitation Letter	1	09-09-2016
Information Sheet	2	07-11-2016
Consent Form	2	07-11-2016
Inter-professional Education Questionnaire	3	08-09-2016
Focus Group Themes	3	08-09-2016
Diagram Data Collection Method	None	September 2016

If the fieldwork goes beyond the date stated in your application, **31st July 2017**, or there are any other amendments to your study you must submit an 'application to amend study' form to the ERP administrator at research.erps@keele.ac.uk stating **ERP2** in the subject line of the e-mail. This form is available via http://www.keele.ac.uk/researchsupport/researchethics/

Directorate of Engagement & Partnerships
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21/12/2017

Dear Jonathan

PI: Jonathan Berry
Title: The Patient Tamagotchi, Phase 1 – Using Augmented Reality to facilitate nterprofessional Education
Ref: ERP 2308

Thank you for your request to amend your study.

I am pleased to inform you that your request has been approved by the Ethical Review Panel.

If the fieldwork goes beyond the date stated or there are any other amendments to your study you must submit an 'application to amend study' form to the ERP administrator at research.governance@keele.ac.uk stating **ERP 2308** in the subject line of the e-mail. This form is available via http://www.keele.ac.uk/researchsupport/researchethics/

If you have any queries, please do not hesitate to contact me.

Yours sincerely
PP.

Dr Colin Rigby
Chair – Ethical Review Panel

Appendix 2 – Example Recruitment Email

Think you can deal with an acutely ill patient in real time?

Then this research project might be for you!

We're looking to recruit volunteers from the School of Nursing in order to test KARE-IPE, a new form of educational technology. KARE-IPE is a real-time virtual patient simulation delivered via iPad, it works in a similar manner to Tamagotchi toys which were popular in the late 1990s. If you treat the patient well, his condition will improve, make less suitable choices and he will deteriorate. You will have complete control over all decisions regarding his care. This technology has previously been piloted on healthcare students and was positively evaluated with quotes such as:

"It's a lot more realistic than a case study, you're a lot more invested in it. You have to think a lot more."

"It's useful, definitely. It's a bit sleeker than having all paperwork and hassle."

"I enjoyed the real time aspect of everything, physically seeing the effect of the change that we made."

What would I have to do?

You will be invited to one, three hour session at 2pm **on Wednesday 31st January 2018, Wednesday 14th February 2018 or Wednesday 21st February 2018.** This will take place at the Keele campus. The session will consist of you working in a team of three alongside fellow students from the Faculty to diagnose, monitor and treat a patient admitted to hospital with a common illness. Five groups of three will be present at each session. The simulation is expected to last approximately one to two hours. A de-brief and focus group will follow the simulation which will investigate your interaction with the technology and each other during the simulation.

Are there any advantages if I participate?

CPD certificates will be given to all students. As this is a simulated learning experience, I will be able to sign nurses logs for three hours of placement activity. You will also be contributing to the improvement of IPE across the faculty and beyond the University. There may be scope for further activity and research into this area and the possibility of a staff-student project.

If I'm interested what should I do?

Express your interest in an email to the lead researcher Jonathan Berry at j.d.berry@keele.ac.uk. You will then be given a consent form and participant information sheet to read which will give you more detail about the project.

What if I'm interested but can't make the dates?

Please feel free to get in touch if the dates are inconvenient, as there may be further opportunity to participate later in the academic year.

This project has received ethical approval from Keele University ref ERP 2308.

Appendix 3 – Participant Information Sheet

INFORMATION SHEET

Study Title: *The Patient Tamagotchi – Phase 1. Using Augmented Reality to facilitate Interprofessional Education*

Invitation
You are being invited to consider taking part in the research study *The Patient Tamagotchi – Phase 1.* This project is being undertaken by *Jonathan Berry under the supervision of Prof.Stephen Chapman and Dr.Katie Maddock.*

Before you decide whether or not you wish to take part, it is important for you to understand why this research is being done and what it will involve. Please take time to read this information carefully and discuss it with friends and relatives if you wish. Ask us if there is anything that is unclear or if you would like more information.

Aims of the Research
This proof of concept study aims to determine if an interactive simulated virtual patient using augmented reality delivered via tablet computers is feasible, if this intervention will improve undergraduate students' attitudes and skills towards interprofessional education, we also wish to know if the asynchronous nature of the simulation will allow students to learn with minimal supervision from tutors.

Why have I been invited?
You are being invited to take part in this research study because you are an undergraduate student in the School of Medicine, School of Nursing and Midwifery or School of Pharmacy at Keele University.

Do I have to take part?
You are free to decide whether you wish to take part or not. If you do decide to take part you will be asked to sign two copies of a written consent form (one for yourself, one for the research team). You are free to withdraw from this study at any time, without giving reasons. If you decide to withdraw during the focus group any contribution you have made up until that point will be retained for use in the research. All data pertaining to yourself (written or audio recorded) will be destroyed once the total data for the project has been collected and before any analysis is undertaken.

What will happen if I take part?
If you decide to take part you will be invited to complete a written consent form and fill in a questionnaire which should take no longer than ten minutes to complete. Following this you will attend a three hour workshop, where you will work as part of a multidisciplinary team looking after a virtual patient (VP). This team will consist of one student doctor, one student nurse and one student pharmacist. The virtual patient will be delivered via augmented reality, using iPads (provided by the research team) as an interface. The patient will be suffering from a common illness treated in secondary care, you will be expected to diagnose, treat and care for the patient for the duration of the simulation. How you do this is entirely up to yourselves, the patient will respond based on the treatment plan you set out for them. Salient treatment plans will result in an improvement in the VP's condition, less desirable treatment plans will cause a deterioration in the VP's condition. The simulation will last for approximately one hour, after which you will be debriefed by an experienced lecturer in healthcare. Following the de-brief you will be expected to attend a focus group where your opinions on the suitability of the technology and the educational benefits of the simulation will be sought. This will be audio recorded and key themes will be elucidated from the discussion.

PLEASE COMPLETE: ERP060715
Version No: 5
Date: 3.7.18
1 for participant, 1 for researcher

What are the benefits (if any) of taking part?
This pilot study will inform future directions for learning and teaching in interprofessional education at Keele University and in the wider sphere. By taking part you are helping us to change future teaching for the better. Phase 2 of this study will aim to deliver the same simulation using mobile phone technology over a period of three days, which will alleviate some of the major barriers to successful delivery of IPE. On a personal level this educational initiative should enable you to focus on how interprofessional collaboration is key whilst dealing with patients in secondary care.

What are the risks (if any) of taking part?
Taking part in this study should pose no risk to you. All data gathered in this study will be anonymised at the point of collection as you will be assigned an alphanumeric code based on your professional background e.g M001, P002 etc. Any data collected via focus groups or the application will be securely stored on password protected media and servers hosted within the EU. Hardcopies of data will be stored in a locked cabinet, separate to consent forms, in a lockable office at Keele University, accessible only by the research team and will be destroyed once the data has been transferred to the laptop/server. Any audio recorded will be stored on a datacorder which will be stored in a locked filing cabinet and transferred to the secure laptop/server ASAP.

How will information about me be used?

Data gained from questionnaires, focus groups, interviews and observational study will be triangulated. The data collected from this study will form the basis of my PhD thesis in interprofessional education. Short anonymised quotes may be included in the thesis and in any publication in scientific literature. Further ethical approval will be sought for phase 2 of the study. The data will be stored for future longitudinal study, further ethical approval will be sought for this and you will be contacted at the time of this future study in order to give consent for the data to be used.

Who will have access to information about me?
All data will be anonymised at the point of collection. It will be stored securely on password protected media and servers hosted within the EU. Hardcopies of data will be stored in a locked cabinet, separate to consent forms, in a lockable office at Keele University, accessible only by the research team (Researcher, Supervisor and Co-Supervisor). Data will be retained by the principle investigator for five years in order to inform longitudinal follow up.

I do however have to work within the confines of current legislation over such matters as privacy and confidentiality, data protection and human rights and so offers of confidentiality may sometimes be overridden by law. For example in circumstances whereby I am concerned over any actual or potential harm to yourself or others I must pass this information to the relevant authorities.

Who is funding and organising the research?
This research has been entirely funded and organised by the School of Pharmacy, and IPE sub-committee of Keele University.

What if there is a problem?
If you have a concern about any aspect of this study, you may wish to speak to the researcher(s) who will do their best to answer your questions. You should contact Jonathan Berry at j.d.berry@keele.ac.uk. Alternatively, if you do not wish to contact the researcher(s) you may contact Professor Stephen Chapman at s.r.chapman@keele.ac.uk.

If you remain unhappy about the research and/or wish to raise a complaint about any aspect of the way that you have been approached or treated during the course of the study please write to Nicola Leighton who is the University's contact for complaints regarding research at the following address:-

Nicola Leighton
Research Governance Officer
Directorate of Engagement and Partnerships
IC2Building
Keele University
ST5 5NH
E-mail: n.leighton@keele.ac.uk
Tel: 01782 733306

Contact for further information:

If you have any questions or require any further information, either now or at any time during the study, please contact me Jonathan Berry at j.d.berry@keele.ac.uk Tel 01782 734793. Alternatively, you can contact me in writing at the School of Pharmacy, Keele University, Staffordshire ST5 5BG.

Appendix 4 – Consent Form

CONSENT FORM

Title of Project: *The Patient Tamagotchi – Phase 1 Using Augmented Reality to facilitate Interprofessional Education*

Name and contact details of Principal Investigator: *Jonathan Berry, Academic Clinical Educator, School of Pharmacy, Hornbeam HNB2.16. Email j.d.berry@keele.ac.uk,*

Please initial box if you agree with the statement

1.	I confirm that I have read and understood the information sheet dated **1/11/17 (version no 4)** for the above study and have had the opportunity to ask questions	☐
2.	I understand that my participation is voluntary and that I am free to withdraw at any time until the closure of the focus group	☐
3.	I agree to take part in this study.	☐
4.	I understand that data collected about me during this study will be anonymised before it is submitted for publication.	☐
5.	I agree to the focus group being audio recorded and I agree for anonymised short quotes from it to be used	☐

_______________________ ____________ ________________________
Name of participant Date Signature

_________________________ ______________ _______________________
Researcher Date Signature

Page 1 of 1

PLEASE COMPLETE:
Version No: 4
Date: 1.11.17
1 for participant, 1 for researcher

ERP060715

Appendix 5 – Phase 1 Participant Briefing

Keele University

Patient Tamagotchi – Phase 1 Briefing

Bertie Wooster aged 64 has been referred to A&E via his GP as he has low oxygen saturations. He has a long history of COPD, and lives at home with his wife Patricia. He weighs 75kg and smoked 20 cigarettes per day for 40 years until he gave up ten years ago.

A short referral letter from the GP is included below: -

The Medical Team

Kettleton Hospital

Staffs

Dear Sir/Madam,

Please would you kindly review this charming 64 year old gentleman who presented to me three days ago with an acute exacerbation of COPD, he has been treated with Doxycycline 200mg stat then 100mg OD and oral steroids without improvement. He presented to me again this morning with increased SOB and a wheeze audible without auscultation, his extremities showed signs of peripheral cyanosis. On examination his SpO_2 was 85% and temp 37.8°C.

Yours Faithfully

Dr Adam Brown MBBS, MRCGP

You are the multi-disciplinary team tasked with the care of Bertie for the next 72 hours. As with a real patient you may ask questions, examine him, order lab tests, prescribe drugs, undertake routine observations and write notes about your patient.

Appendix 6 - Focus group topic guides

Preamble: Welcome and many thanks for taking part today. May I remind you that anything you have said today will be handled confidentially. If anyone has any concerns regarding this, or if anyone would like to withdraw from the study, please notify me before the focus group has been completed.

Please note these questions are intended to facilitate discussion amongst members of the group, they should not be followed as a rigid template.

Theme - Education (interprofessional)

1) Do you feel the simulation helped you to communicate with each other?

   How did you think it aided/hindered the communication?

2) Did the simulation make you collaborate with the other professions?

   What features of the simulation facilitated this?

3) Did the simulation make you feel like a valued member of a team?

4) How did the simulation compare to your experiences of looking after real patients?

   Did you feel more or less in control? If so, why?

5) Which part of the simulation did you learn the most from?

6) Did the simulation make you feel more aware of what other professions can do?

7) Did the simulation reveal anything about yourself that you did not know?

Theme - Education (disease specific)

9) Did the simulation teach you any lessons about managing the disease state?

10) Do you feel that it could be used as a standalone tool for education?

11) Did anything happen in the simulation that was unexpected?

   Do you agree with everything that happened?

      If not, why not?

12) Do you now feel more equipped to handle similar cases in future?

   If not, why not?

Are there any other suggestions you could make to help improve your confidence when caring for a patient with this disease state?

Theme - Technological (mobile)

13) Was the application easy to use?

If not, what sort of difficulties did you encounter?

Did you overcome these difficulties, how?

14) Do you think the app would work with minimal facilitation from a lecturer?

15) What were your preconceptions of the technology?

Has the simulation changed any of these?

Could the technology be used in a different manner?

16) Do you think future learning experiences of this nature are worth persuing?

Theme - Technological (avatar)

17) Does the presence of the avatar improve the learning experience?

Or does it detract from the learning experience?

18) Do you think it is realistic?

If not what could be improved about it?

19) Is the avatar necessary?

Would you have the same experience if you were just fed a briefing note containing critical information about the patient?

Theme- Technological (simulation)

20) Was the entire experience realistic? Did you feel caught up in the moment?

21) Did you feel that you had enough time to react to the changing condition of the patient?

22) Do you think that the simulation provided a safe environment for you to learn in?

e.g did you feel confident working with everybody

Did you feel comfortable at the debrief session?

23) Do you feel that a similar situation in future could be simulated in real time?

With teams of students taking over the care of the patient on a shift basis?

24) Are there any particular clinical scenarios that you feel would be suited to this kind of simulation?

Appendix 7 -Example of coding transcripts using highlighter pens

Sound file: **STUDENT GROUP B D001 D003 N002 P002 P003 (Part 1 & 2)**

D003 M: We thought we were on top of the infection and then, all of a sudden, his Sats went down [01:35] again and that confused us all and got us in a bit of a panic.

[Laughter].

P002 M: It was the rate that they were dropping as well.

D003 M: I think we had it on fast forward [laughter].

GF: Did you find it fairly true to life, in your experience? I mean I don't know how much experience you have all had of managing COPD patients but was it fairly reasonable?

P003 M: Not the death [02:01].

P002 M: Yeah, minus the death [laughter].

doing breathing

N002 F: I think if you could see the patient improving or [02:13], you can tell a lot from how the patient is positioned in bed, and what they're doing.

GF: Yeah, I mean I think that's a valid criticism because he's fairly stable in bed. Are there any particular breathing styles that you'd like to see or what would you be looking for there?

D001 M: Almost like a constant noise coming from the patient with their breathing, obviously.

GF: So rather than an auscultation?

D001 M: Yeah, that as well but yeah.

P002 M: A really good idea, apart from the fact that maybe if you're doing it like we were, the constant breathing could get a bit annoying.

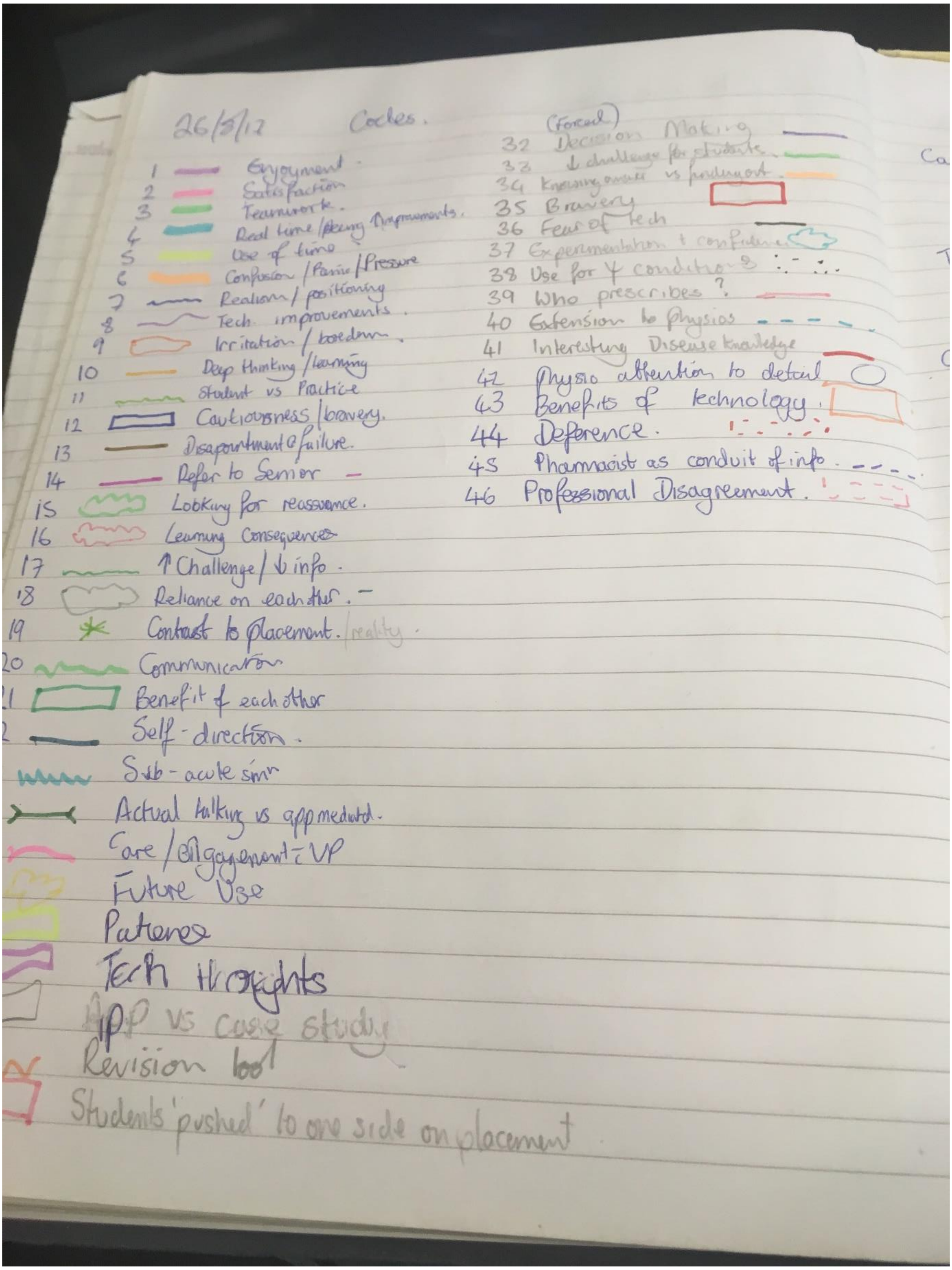
D001 M: Or when you look at him, you could hear him.

over him. ~~R003: almost like another screen.~~

'002 M: Yeah, when you're directly [03:00 – participants over talking].

'003 M: Once you go to that screen with him on, that would be cool.

2



26/3/17 Codes.
1 Enjoyment.
2 Satisfaction
3 Teamwork.
4 Real time / seeing improvements.
5 Use of time
6 Confusion / Panic / Pressure
7 Realism / positioning
8 Tech improvements.
9 Irritation / boredom.
10 Deep thinking / learning
11 Student vs Practice
12 Cautiousness / bravery.
13 Disappointment & failure.
14 Refer to Senior
15 Looking for reassurance.
16 Learning Consequences
17 ↑ Challenge / ↓ info.
18 Reliance on each other.
19 Contrast to placement. / reality.
20 Communication
21 Benefit of each other
22 Self-direction.
Sub-acute sim
Actual talking vs app mediated.
Care / engagement c̄ VP
Future Use
Patience
Tech thoughts
App vs case study
Revision tool
Students 'pushed' to one side on placement
(Forced)
32 Decision Making
33 ↓ challenge for students.
34 Knowing answer vs judgement.
35 Bravery
36 Fear of tech
37 Experimentation + confidence.
38 Use for ↑ conditions
39 Who prescribes?
40 Extension to physios
41 Interesting Disease knowledge
42 Physio attention to detail
43 Benefits of technology.
44 Deference.
45 Pharmacist as conduit of info.
46 Professional Disagreement.

Appendix 8 -Initial Codes and Themes

Codes

Number	Name	Number	Name	Number	Name
1	Enjoyment	17	Increasing challenge and reducing information	33	Reducing challenge for students
2	Satisfaction	18	Reliance on each other	34	Knowing answer vs finding out
3	Teamwork	19	Contrast to placements or reality	35	Bravery
4	Real Time/Seeing improvement	20	Communication	36	Fear of tech
5	Use of time	21	Benefit of each other	37	Experimentation and confidence
6	Confusion/ Panic/ Pressure	22	Self-direction	38	Use for psychiatric conditions
7	Realism/Positioning	23	Sub-acute simulations	39	Who prescribes?

8	Technological Improvements	24	Actual talking vs app mediated communication	40	Extension to physio
9	Irritation/Boredom	25	Care/engagement with VP	41	Interesting disease knowledge
10	Deep thinking/ learning	26	Future Use	42	Physio attention to detail
11	Student vs Practice	27	Patience	43	Benefits of technology
12	Cautiousness/bravery	28	Technological thoughts	44	Deference
13	Disappointment at failure	29	App vs case study	45	Pharmacist as conduit of information
14	Refer to Senior	30	Revision tool	46	Professional disagreement
15	Looking for reassurance	31	Students pushed to one side on placement		
16	Learning Consequences	32	(Forced) decision making		

Initial Themes

Theme	Codes
Soft skills (or virtues and vices)	5,6,9,12,13,14,15,25,27,32,35,37, 44
Collaboration	3,18,20,21,39,45,46
Technology	4,7,8,24,25,26,28,36,43
Education	4,5,10,16,17,22,23,26,29,30,32,33,34,43
Reality	4,7,11,19,24,25,31
Future Use	26,38,40
Miscellaneous	1,2,4,41,42

Appendix 9 - Intermediate Themes and Sub-themes

Theme	Sub-themes (if applicable)
Emotions	Desirable emotions Less desirable emotions
Technology	Improvements Thoughts
Education	Future use Application Deep learning
Collaboration	
Reality	Realism Real world comparisons

Appendix 10 - Final Themes and Codes

Theme	Codes
Technology	Enjoyment Satisfaction Real Time Realism/Positioning Technological Improvements Actual talking vs app mediated communication Care/engagement with VP Technological thoughts Fear of tech Benefits of technology
Education	Real Time/Seeing improvement Use of time Deep thinking/ learning Learning Consequences Increasing challenge and reducing information Self-direction Sub-acute simulations Future Use App vs case study Revision tool (Forced) decision making Reducing challenge for students

	Knowing answer vs finding out Benefits of technology Use for psychiatric conditions Extension to physio Interesting disease knowledge Physio attention to detail Student vs Practice Contrast to placements or reality Students pushed to one side on placement
Collaboration	Teamwork Reliance on each other Communication Benefit of each other Who prescribes? Pharmacist as conduit of information Professional disagreement
Intrinsic behaviours	**Use of time (time management)** Confusion/ Panic/ Pressure Irritation/Boredom Cautiousness/bravery Disappointment at failure Refer to Senior Looking for reassurance Care/engagement with VP Patience

	(Forced) decision making Bravery Experimentation and confidence Deference